BASF Corporation

BASF

September 3, 1996

Ms. Diane Sharrow
Project Manager
United States Environmental Protection Agency
Region V, (DRE-8J)
77 West Jackson Street
Chicago, Illinois 60604

RE: Health & Safety Plan, Project Management Plan, QAPP, Field SOP, and Lab SOP Revisions

Dear Ms. Sharrow:

Minor revisions have been made to the Health & Safety Plan, the Project Management Plan, the QAPP, the Field SOPs, and the Lab SOPs. Three copies of the affected pages are attached and one copy is highlighted. The revisions are explained below.

These revisions should satisfy all of the requirements specified in EPA's Conditional Approval and subsequent discussions with EPA's Mr. David Payne.

Health and Safety Plan

The Health and Safety Plan has been revised to correct typographical errors, update the ESE personnel change, and allow the use of Tyvek® booties. A summary of the changes is:

Page 2-1 -- add "by" in the last sentence
Page 2-2 -- correct spelling of Mulberry in Section 2.1
Page 3-1 -- change Bob Veenstra to Douglas Marian
Page 5-3 -- change HSAP to HASP and change WCC to ESE
Page 6-1 -- add Tyvek® booties
Page 6-2 -- add Tyvek® booties and commas in sixth bullet of Section 6.1.2
Page 6-4 -- add Tyvek® booties for level D and level C PPE
Page 6-6 -- add Tyvek® booties for level D and level C PPE

Project Management Plan

Mr. Robert Veenstra, ESE's Project Manager, has left their company and has been replaced with Mr. Douglas Marian. Replace page 3-3 and FIGURE 2 with the revised pages and add FIGURE 3.

QAPP

The QAPP COPY HOLDERS sheet has been revised by eliminating D. Yarborough from the list and to show that the library copy is no longer pending EPA approval. Since ESE's Project Manager has been replaced, replace Section 2.0, page 3 of 8 and FIGURE 2-2 with the revised

pages. EPA's requirement of reducing the sample size from 30 grams to 5 grams in the herbicide procedure has affected the method detection limit of pentachlorophenol. It increased from 2 µg/kg to 5 µg/kg. TABLE 7-4 page 15 has been revised to reflect the increase; replace the existing page with the revised one. In addition, the project schedule has been revised; replace the old schedule with the revised one. The field investigation of the SWMUs and AOCs required more time than originally envisioned.

FIELD SOPs

APPENDIX B TABLE OF CONTENTS

The revisions to the field SOPs have affected the TABLE OF CONTENTS. Page i has been revised to show the name change of the field boring log. Page viii has been revised to reflect the changes in SOP-13. Page ix has been revised by eliminating the DATA SHEET - ELECTRICAL RESISTIVITY SOUNDINGS. Page xii has been revised to reflect the revision in the order of forms, the name change of the field boring log, and the elimination of the DATA SHEET - ELECTRICAL RESISTIVITY SOUNDINGS. Replace existing pages with the revised pages.

Field SOP-1

FIGURE SOP-1-1 and FIGURE SOP-1-2 had been omitted previously. The new page is to be inserted at the end of field SOP-1.

Field SOP-2

The field boring log was changed from the one used by Woodward Clyde to the one used by ESE. It contains all of the essential information and its use should minimize errors. Replace the existing form at the end of SOP-02 with the new one.

Field SOP-13

Field SOP-13 has been revised. The electrical resistivity equipment specified in the existing SOP is no longer available. The revised SOP specifies equipment that is currently available. Also, the technique is slightly different. Replace the existing SOP with the revised one.

Field SOP-18

The GROUNDWATER SAMPLE COLLECTION FIELD SHEET form has been revised to show ESE's name and address. Replace the existing form with the revised form.

Field SOP-19

Page 2 has been revised to reflect the elimination of a form. The Chain of Custody form is to be inserted as the first form in field SOP-19 and the FIELD BORING LOG form is to be replaced with the LOG OF WELL form. The "DATA SHEET - ELECTRICITY RESISTIVITY SOUNDINGS" form is no longer required and needs to be removed from field SOP-19. A replacement page for the EQUIPMENT DECONTAMINATION/WASH CHECKLIST AND RECORD form is attached. Replace the existing GROUNDWATER SAMPLE COLLECTION FIELD SHEET form with the revised one.

LAB SOPs

SOP NC-WC-0032 has been revised to increase the MS/MSD frequency from one per batch to one per 7 samples. In addition, some samples collected in the Prussian blue area will be spiked with a sodium thiocyanate solution to assess the potential impact of thiocyanate in the original sample. Add the attached addendum to the end of SOP NC-WC-0032.

SOP LM-WALN-4110 has been revised by decreasing the non aqueous sample mass from 30 grams to 5 grams. Section 11.4.2 was revised to state that DCAA will be the only surrogate. Table 5 was revised concerning surrogate concentrations. Add the attached addendum to the end of SOP LM-WALN-4110.

SOP CORP-GC-0001 section 17.3 has been revised by reducing the extraction volume and eliminating the 20 fold dilution. Add the attached addendum to the end of SOP CORP-GC-0001.

SOP CORP-MT-0001 Table IV and Table IVA have been revised in order to achieve the Targeted Quantitation Limits listed in the QAPP. Values for barium and copper were revised in Table IV and values for antimony, arsenic, and cadmium were revised in Table IVA. Replace existing SOP pages with the revised pages.

Also attached is the Soil SRM Data report that was requested by Mr. Payne.

Sincerely,

Don Yarborough
Wyandotte Site Manager

cc:
B. Roberts - BASF
R. Vitale - ESI (letter only)
D. Marian - ESE
T. Himes - Quanterra
R. Blayer - MDEQ Lansing
L. Aubuchon - MDEQ Livonia
J. Russell - MDEQ Livonia

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HEALTH AND SAFETY PLAN
RFI WORK PLAN
BASF FACILITY
WYANDOTTE, MICHIGAN

Prepared for:
BASF Corporation
Wyandotte, Michigan
May 1996

Environmental Science & Engineering, Inc.
1099 W. Grand River Avenue
Williamston, Michigan 48895

Project Number: 4695-010
Revision 1

HEALTH AND SAFETY PLAN FOR
RCRA FACILITY INVESTIGATION
BASF FACILITY
WYANDOTTE, MICHIGAN

Bruce Roberts — 6/28/96
Bruce Roberts
BASF Project Coordinator
Date

Douglas Thiel — 6/24/96
Douglas Thiel
BASF Safety Coordinator
Date

Bob Veenstra — 5/24/96
Bob Veenstra
ESE Project Manager
Date

Sarah Buehler — 6/26/96
Sarah Buehler
ESE Local Health & Safety Representative
Date

Arnold R. Kaeppeler CIH/CSP — 5/26/96
Arnold Kaeppeler
ESE Corporate Health & Safety Director
Date

USEPA HSP Reviewer
Date

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

1.0
ADMINISTRATIVE INFORMATION

Project Name:	RCRA Facility Investigation, BASF Corporation
Location:	Wyandotte, Michigan
Date Plan Approved by ESE Corporate Health and Safety Director:	**May 26, 1996**
Reviewers:	_____ (Print Name), USEPA (Chicago, Illinois)
	Sarah Buehler, ESE (Williamston, Michigan) Local Health & Safety Representative
	Arnold Kaeppeler, ESE (Amherst, New Hampshire) Corporate Health & Safety Director
	Douglas Thiel, BASF Corp. (Wyandotte, Michigan)
Accepted by:	_____ Environmental Science & Engineering, Inc.

2.0
INTRODUCTION

This Health and Safety Plan (HSP) addresses field activities to be conducted at the BASF Facility (Figure 1) during the RCRA Facility Investigation (RFI). This plan outlines protocols to protect personnel against potential exposure to hazardous substances and physical hazards during site activities.

This HSP and any subsequent addenda will apply to all BASF personnel, Environmental Science & Engineering, Inc. (ESE) and other contractor personnel who are involved with on-site activities, unless contractors provide their own Health and Safety Plan. If contractors submit their own HSP, it will be reviewed by the BASF Safety Coordinator and ESE's Health and Safety Officer (HSO) and will be approved if its requirements are at least as stringent as those required by ESE's Corporate Health and Safety Programs, and those set forth in this HSP.

ESE field personnel and ESE subcontractor field personnel will participate in health monitoring, respirator fit testing, and hazardous waste training programs as specified by Occupational Safety and Health Administration (OSHA) regulations (see 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response, Final Rule, Federal Register, March 6, 1989). Subcontractors will provide the HSO with documentation of their participation in such programs.

All work will be conducted in compliance with applicable OSHA and MIOSHA regulations, including 29 CFR 1910 (General Industry Standards) and 29 CFR 1926 (Construction Industry Standards).

All employees involved in these operations will be required to read this HSP, and be briefed by the BASF Safety Coordinator and the Site Safety Officer (SSO) before commencement of the site operations.

2.1 SITE DESCRIPTION

The BASF facility is located at 1609 Biddle Avenue, Wyandotte, Michigan (Figure 1). The facility is bounded on the north by Perry Place, on the east by the Detroit River, on the south by Mulberry Street, and on the west by Biddle Avenue. The facility covers approximately 230 acres.

The site is generally flat, sloping toward the east. Approximately two-thirds of the Facility is reclaimed marshlands and river bottom, filled to present grade with a heterogenous mixture of fill material.

2.2 SUMMARY OF PREVIOUS ACTIVITIES

The BASF Wyandotte site began operations in 1893 as the Michigan Alkali Company and produced soda ash for the glass manufacturing industry. It was purchased by BASF in 1969. While owned and operated by BASF Corporation, the Facility has engaged in the manufacture of industrial inorganic chemicals, polyether polyol resins, polyurethane plastics and castings, vitamins A and E, soda ash and coke. Research and pilot activities in support of the chemical manufacturing are also conducted. No fewer than nine nominal Solid Waste Management Units (SWMU) have existed at the Facility, including:

- A 25,300 gallon capacity outdoor container storage area;
- A 100 cubic yard capacity outdoor container storage area,
- Part of a warehouse near Alkali Street;
- A 4,000 gallon capacity above ground storage tank;
- A 2,000,000 gallon per day wastewater treatment surface impoundment;
- Three land disposal units; and
- An emergency containment pond located near the intersection of Huron Road and Wyandotte Road.

The nominal 25,300 gallon capacity hazardous waste container was recognized by the Michigan Department of Natural Resources (MDNR) as closed on June 27, 1991. However, because of soil and groundwater contamination discovered in a June 1981 MDNR investigation, the MDNR denied clean closure.

The nominal 100 cubic yard capacity container storage area was used by the Facility for less than 90 day accumulation of hazardous wastes, generally consisting of waste solvents and ignitable wastes.

The warehouse located inside building 53M just west of Chippewa Street was used from August 11, 1983 to June 22, 1992 to accumulate hazardous wastes for less than 90 days.

The 4,000 gallon capacity above ground tank was previously used to accumulate acetic acid generated as a manufacturing by-product, and is currently used to store heptane for use in manufacturing. Since November 1987, the process has been connected by pipe to a treatment vessel, and the acetic acid is neutralized and discharged to a sanitary sewer as wastewater.

The nominal 2,000,000 gallon per day surface impoundment is used to treat only wastewater that is not regulated as hazardous waste according to RCRA.

The nominal land disposal unit is used for the disposal of waste filter cake generated in the polyol manufacturing process.

The two nominal waste pile units, formerly located on the south end of the Facility, were used for the storage of demolition rubble.

The emergency containment pond was used to treat waste water runoff.

From information developed during historical and current investigations, the following Areas of Concern (AOC) have been identified (Figure 2):

- AOC 1 an area south of the polyol process building.
- AOC 2 old coke plant area.
- AOC 3 old concrete carbose skimmer pit
- AOC 4 Tar Pit
- AOC 5 Dichloropropane disposal area
- AOC 6 South Tar Pit
- AOC 7 Prussian Blue Area
- AOC 8 Styrene Release Area
- AOC 9 PO spill area

On October 31, 1983, the Attorney General for the State of Michigan and the director of the MDNR filed a civil action complaint against BASF alleging that the Facility was subject to serious soil, groundwater, and surface water contamination.

In 1984, a hydrogeologic study was conducted by S.S. Papadopulos & Associates, Inc., consulting groundwater hydrologists to BASF, to assess the flow of groundwater from the Facility to the Detroit River. Subsequently, the "North Works Remedial Program," was designed to prevent the flow of groundwater to the Detroit River via groundwater extraction in three areas: near the southern boundary of the Facility, near the intersection of Wyandotte Road and Alkali Road, and in the vicinity of the polyol plant. Groundwater extracted from these three areas is treated and transferred to the Wayne County Department of Public Works and ultimately to the Detroit River.

On January 6, 1986, a Consent Decree settling the complaint was filed, requiring that the BASF Wyandotte Corporation implement the "North Works Remedial Program."

BASF and the U.S. EPA entered into an Administrative Order on Consent on February 28, 1994. In the Consent Order, BASF agreed to conduct a RFI.

2.3 CHEMICALS OF PRIMARY CONCERN

The hazardous waste constituents identified or potentially present at the site are presented on Table A.

2.4 WORK ZONES

Three work zones will be used during the Site Characterization work: exclusion zone, decontamination zone, and support zone. These zones will be identified by the SSO before each field task begins.

Exclusion Zones: The exclusion zone will include an area at least 20 ft in diameter surrounding on-site sampling stations or that area in which PID or OVA readings are above background levels. The exclusion zones shall use building walls, etc., to serve as the perimeter of designated exclusion zones where applicable. Special protective gear may be required in these zones (see Activity-Specific Requirements).

Decontamination Zones: Personnel performing equipment decontamination will wear personnel protective gear and follow procedures as described under Activity-Specific Requirements in Section 6.0. Specific procedures for decontamination of equipment and personnel are outlined under Decontamination Procedures in Section 6.4. Decontamination stations will be established by the SSO in the field.

Support Zones: The support zones include the location of the administrative and other support functions needed to keep the operations in the exclusion and decontamination zones running smoothly. The support zone will be located outside of the area of the exclusion zone. This zone will be defined by the SSO in the field prior to each of the field tasks.

3.0
KEY PERSONNEL

ESE Health and Safety Officer (HSO):	Arnold Kaeppeler
ESE Site Safety Officer (SSO):	Doug Murphy
ESE Project Manager:.	Douglas Marian
ESE Site Supervisor:	Craig Campbell
USEPA Project Manager:	Diane Sharrow
BASF Safety Coordinator:	Douglas Thiel

3.1 PERSONNEL ROLES

3.1.1 Site Safety Officer

The ESE Site Safety Officer (SSO) is responsible for project safety, decontamination, environmental monitoring and field medical monitoring activities. The SSO will ensure that all field personnel comply with the provisions of this Health and Safety Plan (HSP). The SSO has the authority to stop site work in the event of safety violations. Work will be stopped in order to upgrade to a higher level of personal protection if the SSO determines that such an upgrade is required. The SSO may also stop work if he/she observes any operation that threatens the health and safety of site personnel. The SSO is responsible for designating and marking work zones and for restricting access to Exclusion Zones and Decontamination Areas. For example, access will be denied to personnel without the proper personal protective equipment and training in accordance with 29 CFR 1910.120.

The SSO reports directly to the Health and Safety Officer (HSO) and should refer all safety-related questions to the BASF Safety Coordinator. The SSO will keep the HSO and the Technical Project Manager informed of the status of safety-related site activities and assessments. The SSO will notify the HSO and Project Manager, as soon as possible, of any exposure incidents, injuries, accidents or

emergency situations should use the BASF Accident/Incident Report Form, as well as the ESE accident report form. Both forms are provided in Attachment A.

All ESE, ESE-contracted personnel, other contracted personnel and BASF personnel scheduled for field work at the Site will receive an initial health and safety briefing by the SSO and BASF Safety Coordinator prior to starting work activities. The briefing will include a thorough review of this HSP. Daily on-site briefings will be conducted by the SSO to reinforce health and safety awareness and to allow personnel the opportunity for comments or questions. Daily Safety Meeting Checklists (Attachment E) will be completed to document these briefings.

Each contractor will have an assigned site safety contact that will report to the ESE Site Safety Officer and BASF Safety Coordinator. This contact will be responsible for ensuring contractor employees are complying with the HSP, providing contractor health and safety records to the ESE and assisting with project safety, decontamination, environmental monitoring and field monitoring activities.

3.1.2 Project Manager

The project manager has the primary responsibility for the fulfillment of the terms of the work plan. The manager must oversee operations and ensure that all legal and safety requirements are met. The manager must keep the project on schedule and within budget, and to communicate daily with the site supervisor regarding the progress toward the specified goals.

3.1.3 Site Supervisor

The site supervisor is the on-site coordinator (task leader) and overseer of operations. It is the site supervisors's duty to maintain site security, supervise the laborers and technicians, and ensure that all health and safety related procedures are followed.

4.0 POTENTIAL HEALTH AND SAFETY HAZARDS

4.1 POTENTIAL CHEMICAL HAZARDS

Previous investigations were summarized in Section 2.2. Sampling results indicate that there are chemicals within limited areas of the facility which may present a human health hazard during intrusive activities. We cannot assume, however, that the previous sampling activities have identified all of the chemicals of concern and all of the locations with high concentrations of these chemicals.

Contaminants of concern were determined by identifying compounds which:

- May produce deleterious human health effects,
- Are available in a dose high enough to cause such an effect, and
- Are available in a form which can contact the skin and/or enter the body and contact target organs.

It is assumed that the only routes of exposure for on-site workers to waste, soils, water and air would be inhalation and skin contact. Ingestion of these media should not be a concern as long as personnel adhere to good personal hygiene practices and to the site prohibitions outlined in this HSP. Based on this assumption, it was necessary to compare sampling results to acceptable air concentrations to determine contaminants of concern.

OSHA standards and NIOSH recommendations were reviewed to identify which contaminants were identified as a skin hazard. Any chemical which was present in the soil or groundwater which had such a designation was identified as a potential direct contact hazard.

Among the hazardous waste constituents found at the Facility in soil or groundwater, IRIS listed the following chemicals as known human carcinogens:

benzene

The following constituents identified at the Facility have been listed by IRIS as probable human carcinogens:

> acrylonitrile, aniline, benzo(b)fluoranthene, benzo(a)pyrene, cadmium, chloroform, chrysene, dichloroethyl ether, 1,2-dichloropropane, fluoranthene, hexachlorobutadiene, methylene chloride, trichloroethylene, and vinyl chloride

The following constituents identified at the Facility have been listed by the IRIS as systemic toxicants:

> chlorobenzene, p-chloro-m-cresol, chromium, cresol, dichlorophenol, diethyl phthalate, 2,4 dimethylphenol, fluorene, lead, naphthalene, phenol, phthalic acid ester, pyridine, styrene, toluene, and 1,2,3-trichloropropane.

Wastes exhibiting the characteristics of ignitability (including pyrophoric) and corrosivity have been managed at the Facility and may be encountered by field workers.

These hazardous constituents pose a potential threat to the health of humans and the physical and biotic environment. The OSHA exposure limits for the hazardous constituents listed above are presented in Table B.

4.2 POTENTIAL PHYSICAL HAZARDS

It is possible that surface materials will collapse into uncased boreholes during drilling operations. Extreme care should be taken when this condition is suspected.

The personal protective equipment (PPE) which may be required for some activities places a physical strain on the wearer and may increase the risk of heat stress. Attachment B contains criteria for identification and prevention of heat stress. In addition, PPE such as respirators, gloves, hard hats, and protective clothing may limit visibility, hearing, and manual dexterity.

Excessive noise may be generated from drilling rigs, facility equipment and heavy construction equipment.

The hazards involved with the use of drill rigs are significant and include the hazards of pinch points, entrapment in machinery, impact from moving parts, fatigue, electrocution from lightning, overhead

wires, or buried utilities, and improper operations. Use of hand tools, moving the rig, and conducting required repairs can increase physical risks. Working with and around a drill rig can involve a high risk of serious injury or death.

Work around heavy equipment can always be dangerous. Due to the limited ability to communicate when wearing respiratory protection, the risk can be increased. Workers must be careful to communicate with heavy equipment operators regarding their location and should maintain a safe distance from operating equipment at all times.

5.0
GENERAL HEALTH AND SAFETY REQUIREMENTS

5.1 PERSONNEL CLEARANCE

All personnel involved with field work at the site must obtain health and safety clearances before beginning work at this site. All personnel involved in collecting samples or entering the exclusion zone must (1) be certified by a physician as being physically fit and able to perform their assigned field work, (2) have successfully completed a 40-hour basic health and safety training course (Level C) for field personnel or the equivalent, and (3) passed a respirator fit test with amyl nitrite and/or irritant smoke as indicators. The clearance requirements will comply with 29CFR1910.120. Site managers and supervisors must have successfully completed an 8-hour manager's health and safety course in addition to all other clearance requirements. The Site Safety Officer must be Red Cross-certified in CPR and First Aid in addition to requirements for field personnel.

5.2 SAFETY BRIEFINGS

5.2.1 Initial Safety Meeting

Before field work begins, all field personnel, including contractor employees, must be briefed on their work assignments and safety procedures contained in this document. Each must be provided with a copy of this Health and Safety Plan. At the end of the meeting, attendees should be informally quizzed by the SSO to assess their understanding of the health and safety requirements, and should sign a safety compliance agreement form stating that they have read, understand, and agree to comply with the provisions of this plan. Individuals refusing to sign the agreement will be prohibited from working at the site.

The SSO will conduct this briefing. The documentation form for the briefing is attached in Section 12. This form is to be completed and maintained in the ESE's records, including the Health and Safety file.

5.2.2 Tailgate Safety Meetings

"Tailgate" Safety meetings will be conducted at a minimum on a daily basis, or as hazards and/or work plan changes for on-site personnel by the SSO. The discussion at these meetings will include:

- The health and safety considerations and necessary protective equipment for the current operations,
- Any addenda to the HSP,
- Any new Material Safety Data Sheets (MSDS) filed on-site that are relevant to the field investigation and
- All documented and/or observed unsafe acts committed on the site since the previous meeting and methods to prevent recurrence.

Tailgate Safety Meetings will be documented in the Health and Safety Log Book and on Daily Safety Meeting Checklists (Attachment E) and include, as a minimum, the topic of discussion and names of employees present and each person's affiliation.

5.3 VISITOR CLEARANCE

All visitors entering the decontamination zone and exclusion zone at the site will be required to read and verify compliance with the provisions of this HSP. In addition, visitors will be expected to comply with all BASF safety requirements, ESE safety requirements, and relevant OSHA requirements such as medical monitoring (Section 5.0) training (Subsection 5.1), and respiratory protection (if applicable). Visitors will also be expected to provide their own protective equipment.

In the event that a visitor does not adhere to the provisions of the HSP, he/she will be requested to leave the work area. All nonconformance incidents will be recorded in the site log, and recorded in the BASF Accident/Incident Report. A copy of the report will be given to the BASF Safety Coordinator.

5.4 DISTRIBUTION OF HEALTH AND SAFETY PLAN

Before site work begins, a copy of this Health and Safety Plan must be provided to each field worker assigned to work at the site as well as to an authorized representative of each firm contracted by BASF to perform work on-site. The Site Safety Officer will ensure that each field worker has read

and understood the contents of the Health and Safety Plan, and that each field worker has signed the HASP Acknowledgement (Attachment F) before initiating work at the site. The Site Safety Officer is responsible for ensuring that a copy of the plan is available whenever work is in progress.

5.5 ACCIDENT/INCIDENT REPORTING

In the event of an accident or incident, the SSO will immediately notify the ESE PM, HSO, CHSC and the BASF Safety Coordinator. In addition, ESE's accident/incident reporting protocol will be employed. Types of accidents or incidents that are considered reportable are:

- Illness resulting from chemical exposure or unknown causes,
- Physical injury, including an injury that does not require medical attention,
- Fire, explosions, and flashes resulting from activities performed by ESE and its subcontractors,
- Infractions of safety rules and requirements,
- Unexpected chemical exposures, or
- Near accidents.

Work will be suspended to correct the cause of the accident/incident and to modify this plan as necessary.

The BASF Accident/Incident Report Form must be submitted to the Project Manager and the Health and Safety Officer within 24 hours of the occurrence. An ESE Accident report form (Attachment A) will also be filled out and submitted to the ESE project manager and Health and Safety Officer. A copy must also be made for the BASF Safety Coordinator.

5.5.1 Reporting of Hazards to EPA

If a field worker identifies an immediate or potential threat to human health and/or the environment, new releases of hazardous material, or new SWMUs not previously identified, a BASF representative shall orally notify the EPA Project Coordinator within 48 hours of discovery (or the Region V Emergency Response Line during weekends and holidays). BASF must also notify the EPA in writing within 14 days of the discovery, summarizing the immediacy and magnitude of the potential threat to human health or the environment. Upon reviewing the written request of the EPA, BASF shall submit to EPA an Interim Measures (IM) workplan in accordance with the IM Scope of Work.

If EPA determines that immediate action is needed, the EPA Project Coordinator may orally authorize BASF to commence IM field work prior to EPA's receipt of the IM Workplan.

5.6 SAFETY COMPLETION REPORT

The Site Safety Officer will prepare a safety completion report at the end of field activities which includes a critical review of this plan, exposure monitoring data with monitoring dates, and any decisions made based on the data, a summary of incidence and action taken, and recommendations for improving health and safety at similar sites. (This report form is in Attachment A).

5.7 WORK ZONES

Work zones will be required for specific site activities. For these activities the following procedures are mandatory. Three work zones will be established around each sampling location: the exclusion zone, the decontamination zone, and the support zone. An exclusion zone is an area where contamination could or does occur. The exclusion zone will be marked using flagging. All ESE or contractor personnel who enter the exclusion zone must be cleared by the SSO, have signed a safety compliance agreement form, and wear the level of protective equipment specified in Section 6.0 of this plan. The exclusion zone will be a minimum of 20 feet (in all directions) from any intrusive activities. Provisions shall be made for areas where buildings, etc., inhibit the 20 ft exclusion zone.

The decontamination zone is located immediately outside the exclusion zone. This zone is designed to limit the migration of contaminants from potentially contaminated areas to noncontaminated areas. Decontamination facilities are located in this area. Personal Protective Equipment (PPE) must be decontaminated as outlined in Section 6.4. The level of PPE in the decontamination zone will typically be one level lower than PPE in the exclusion zone. When decontamination activities are not being conducted, the level of protection for this zone will be D.

The support zone is an uncontaminated area. Supporting equipment and facilities will be located in this area.

6.0 ACTIVITY-SPECIFIC HEALTH AND SAFETY REQUIREMENTS

Requirements specific to the data gathering and sampling activities at the North Works are described in this section. Media targeted for sampling include surface soils, subsurface soils, groundwater, sediment in a pond and wastes. Sediments in the Trenton Channel will not be addressed in this phase of the RFI but may be sampled in a subsequent phase of this RFI. Therefore, a Health and Safety Plan for sediment sampling will be proposed as an Addendum to this plan if it becomes necessary.

Chemicals of concern and their respective Permissible Exposure Limits (PELs), Ionization Potentials (IPs) and other characteristics are provided in Table B. The information provided in this section shall be used in conjunction with information provided in Table B as a guide for air monitoring, PPE selection and PPE upgrade.

6.1 ACTIVITY-SPECIFIC REQUIREMENTS FOR SOIL SAMPLING

This activity includes soil sampling. This activity anticipates requiring Level C or D protective equipment and a minimum of two ESE or subcontracted personnel to perform. The consultant will oversee the sampling activities.

6.1.1 **Personal Protective Equipment** (to be worn within Exclusion Zone)

Level D Protective Uniform

- Hard hat (if overhead hazards are present)
- Safety glasses or goggles
- Poly-coated Tyvek® suit (if muddy conditions exist)
- Steel toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)
- Disposable nitrile surgical gloves
- Hearing protection (when noise levels exceed 85 db or prohibit normal conversation at one-arm's length distance)

Level C Protective Uniform

- Full-face respirator (FFR) with organic vapor/acid gas/dust cartridges
- Hard hat (if overhead hazards are present)
- Poly-coated Tyvek® suit (replace when ripped)
- Steel-toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)
- Outer nitrile gloves
- Disposable inner surgical gloves
- Hearing protection (when noise levels exceed 85 db or prohibit normal conversation at one-arm's length distance)

Level B Protective Uniform

- Supplied air respirator or self-contained breathing apparatus - full facepiece
- All other elements of the Level C protective uniform
- Hearing protection (when noise levels exceed 85 db or prohibit normal conversation at one-arm's length distance)

6.1.2 Monitoring and Other Equipment:

- Photoionization Detector (i.e., PID equipped with 10.2eV bulb or high energy lamp) or Organic Vapor Analyzer (OVA)
- Draeger tubes and pump - compound specific (e.g., benzene, acrylonitrile, vinyl chloride)
- Eye wash kit
- First Aid kit
- Fire extinguisher
- Personal air sampling pump with tubes/cassette for breathing zone monitoring for compounds detected in breathing zone such as benzene, acrylonitrile, vinyl chloride, hexachlorobutadiene, and coal tar pitch volatiles
- Ram 1 dust monitor

6.1.3 Hazard Evaluation

- Back away from exclusion zone after obtaining PID/OVA readings above Level C action level (Section 6.1.4).
- Screen exclusion zone with appropriate compound-specific Draeger tubes (use Level B Protective Uniform).
- Selection of Draeger tubes will be based on suspected constituents of concern in that portion of the North Works Facility where the work is taking place. For example, around the Polyols Plant, acrylonitrile is suspected to be present, so Draeger tubes sensitive to acrylonitrile would be used. In AOC 5 or SWMU H, propylene dichloride is suspected to be present, so workers in these areas will be equipped with Draeger tubes sensitive to this compound. In SWMU E, vinyl chloride is expected

6.1.3 Hazard Evaluation

- Back away from exclusion zone after obtaining PID/OVA readings above Level C action level (Section 6.1.4).
- Screen exclusion zone with appropriate compound-specific Draeger tubes (use Level B Protective Uniform).
- Selection of Draeger tubes will be based on suspected constituents of concern in that portion of the North Works Facility where the work is taking place. For example, around the Polyols Plant, acrylonitrile is suspected to be present, so Draeger tubes sensitive to acrylonitrile would be used. In AOC 5 or SWMU H, propylene dichloride has been detected in soil and released vapor as confirmed by charcoal tube analyses. Trichloropropane and bis(2-chloroisopropyl) ether were detected in soil samples, but were not detected in any vapor samples from these two areas. Vinyl chloride has not been detected in any soil or vapor screening samples from these areas. In SWMU E, vinyl chloride is expected to be present, so workers in this area will be equipped with Draeger tubes sensitive to this compound.
- Equip workers with appropriate level of personal protective equipment prior to resuming work.

6.1.4 Conditions Warranting Upgrade to Level C Protective Equipment

- Level C personal protective equipment will be utilized if the PID or OVA readings are above background in the breathing zone
- For work activities in AOC 5 and SWMU H where Level C is deemed necessary, respirator cartridges will be exchanged at a minimum frequency of every 2 hours.
- For work activities in AOC 5 or SWMU H: i) monitoring will be conducted at a frequency of every 15 minutes, ii) if PID or OVA readings above 5 ppm are detected in the breathing zone of any individual within the exclusion zone, continuous monitoring will be provided until levels decrease below 5 ppm , and iii) if PID or OVA levels continue to exceed 5 ppm for a sustained 5-minute period, then work will cease and personnel will leave the area.
- When visible dust can't be controlled in the breathing zone and dust monitoring results exceed 1 kg/mg^3 total dust, characterize dust and revise HASP

6.1.5 Conditions Warranting Upgrade to Level B Protective Equipment

- Sustained PID or OVA readings for 5 minutes that exceed 5 ppm
- Screening of the exclusion zone with compound-specific Draeger tubes indicates concentrations of chemicals in the breathing zone that exceed the capacity of a full-face respirator
- Any detectable concentration of acrylonitrile
- Any detectable concentration of benzene
- Any detectable concentration of vinyl chloride

6.1.6 Conditions Warranting Cessation of Work and Leaving Area Immediately (notify Health and Safety Officer):

- Emergency signal is given
- Member of field team experiences symptoms possibly related to chemical exposure such as dizziness or nausea; or heat/cold stress (see Attachment B)
- Any monitoring equipment malfunctions; work may resume once the instruments are in working order
- Excessively dusty conditions that cannot be controlled by dust-wetting.
- Sustained PID or OVA reading of 5 ppm above background in breathing zone for 5 minutes

6.1.7 Activity-Specific Hazards:

- Dermal hazard related to contact with potentially contaminated on-site soil and groundwater
- Inhalation hazard related to escaping soil or groundwater gases

Skin or eye contact with the site chemicals will be minimized by the appropriate use of Tyvek® suits, goggles, gloves and disposable outer boots.

6.2 ACTIVITY-SPECIFIC REQUIREMENTS FOR GROUNDWATER SAMPLING

This activity is anticipated to require Level D protective equipment.

6.2.1 **Personal Protective Equipment** (to be worn within Exclusion Zone)

Level D Protective Uniform

- Hard hat (when overhead hazards are present)
- Safety glasses or goggles
- Poly-coated Tyvek® suit
- Steel toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)
- Nitrile (surgical) gloves

Level C Protective Uniform

- Full-face respirator with organic vapor/acid gas/dust cartridges
- Hard hat (when overhead hazards are present)
- Poly-coated Tyvek® suit (replace when ripped)
- Steel-toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)
- Outer nitrile gloves
- Inner surgical gloves

Level B Protective Uniform

- Supplied air respirator or self-contained breathing apparatus - full facepiece
- All other elements of the Level C protective uniform

6.2.2 **Monitoring and Other Equipment:**

- PID (10.2eV) or OVA,
- Eye wash kit, and
- First Aid kit

- Draeger tubes and pump - compound specific (e.g., benzene, acrylonitrile, vinyl chloride)

6.2.3 Hazard Evaluation

- Back away from exclusion zone after obtaining PID/OVA readings above Level C action level (Section 6.2.4).
- Screen exclusion zone with appropriate compound-specific Draeger tubes.
- Selection of Draeger tubes will be based on suspected constituents of concern in that portion of the North Works Facility where the work is taking place. For example, around the Polyols Plant, acrylonitrile is suspected to be present, so Draeger tubes sensitive to acrylonitrile would be used. In AOC 5 or SWMU H, propylene dichloride has been detected in soil and released vapor as confirmed by charcoal tube analyses. Trichloropropane and bis(2-chloroisopropyl) ether were detected in soil samples, but were not detected in any vapor samples from these two areas. Vinyl chloride has not been detected in any soil or vapor screening samples from these areas. In SWMU E, vinyl chloride is expected to be present, so workers in this area will be equipped with Draeger tubes sensitive to this compound.
- Equip workers with appropriate level of personal protective equipment prior to resuming work.

6.2.4 Conditions Warranting Upgrading to Level C (notify Health and Safety Officer):

- Sustained PID or OVA readings above background in the breathing zone
- For work activities in AOC 5 and SWMU H where Level C is deemed necessary, respirator cartridges will be exchanged at a minimum frequency of every 2 hours.
- For work activities in AOC 5 or SWMU H: i) monitoring will be conducted at a frequency of every 15 minutes, ii) if PID or OVA readings above 5 ppm are detected in the breathing zone of any individual within the exclusion zone, continuous monitoring will be provided until levels decrease below 5 ppm , and iii) if PID or OVA levels continue to exceed 5 ppm for a sustained 5-minute period, then work will cease and personnel will leave the area.

6.2.5 Conditions Warranting Upgrade to Level B Protective Equipment

- Sustained PID or OVA readings for 5 minutes that exceed 5 ppm
- Screening of the exclusion zone with compound-specific Draeger tubes indicates concentrations of chemicals in the breathing zone that exceed the capacity of a full-face respirator
- Any detectable concentrations of acrylonitrile
- Any detectable concentrations of benzene
- Any detectable concentrations of vinyl chloride

6.2.6 Conditions Warranting Cessation of Work and Leaving Area Immediately (notify Health and Safety Officer):

- Emergency signal is given
- Member of field team experiences symptoms possibly related to chemical exposure such as dizziness or nausea, or heat/cold stress (see Attachment B)
- Excessively dusty conditions that cannot be controlled by dust-wetting
- Any monitoring equipment malfunction - work may resume once the instruments are in working order
- Sustained PID readings of 5 ppm above background for 5 minutes in the breathing zone

6.2.7 Activity-Specific Hazards:

- Potential dermal contact with on-site groundwater
- Splash potential
- Inhalation hazard related to escaping groundwater gases

Eyes and skin will be protected by wearing protective outer clothing and goggles or safety glasses.

6.3 ACTIVITY-SPECIFIC REQUIREMENTS FOR GEOPHYSICAL SURVEYING, SURVEYING, AND SITE RECONNAISSANCE

It is anticipated that these non-intrusive activities will be performed in Level D protective equipment.

6.3.1 Personal Protective Equipment

Level D Protective Uniform

- Hard hat (when overhead hazards are present)
- Safety glasses or goggles
- Long sleeve shirts
- Steel-toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)

Level C Protective Uniform

- Full-face respirator with organic vapor/acid gas/dust cartridges
- Hard hat (when overhead hazards are present)
- Poly-coated Tyvek® suit (replace when ripped)
- Steel-toed and shanked boots
- Tyvek® disposable booties, to be changed as needed (if conditions are wet and moisture will penetrate booties, upgrade to disposal latex overboots, to be changed at least daily)
- Outer nitrile gloves
- Inner surgical gloves

Level B Protective Uniform

- Supplied air respirator or self-contained breathing apparatus - full facepiece
- All other elements of the Level C protective uniform

6.3.2 Monitoring and Other Equipment:

- PID (10.2eV) or OVA,
- Eye wash kit, and
- First Aid kit

- Draeger tubes and pump - compound specific (e.g. benzene, acrylonitrile, vinyl chloride)

6.3.3 Hazard Evaluation

- Back away from exclusion zone after obtaining PID/OVA readings above Level C action level (Section 6.3.4).
- Screen exclusion zone with appropriate compound-specific Draeger tubes.
- Selection of Draeger tubes will be based on suspected constituents of concern in that portion of the North Works Facility where the work is taking place. For example, around the Polyols Plant, acrylonitrile is suspected to be present, so Draeger tubes sensitive to acrylonitrile would be used. In AOC 5 or SWMU H, propylene dichloride is suspected to be present, so workers in these areas will be equipped with Draeger tubes sensitive to this compound. In SWMU E, vinyl chloride is expected to be present, so detector tubes sensitive to this compound will be used.
- Equip workers with appropriate level of personal protective equipment prior to resuming work.

6.3.4 Conditions Warranting Upgrading to Level C (Notify Health and Safety Officer):

- Sustained PID or OVA readings above background in breathing zone.
- When visible dust can't be controlled in the breathing zone and dust monitoring results exceed 1 kg/m^3 total dust, characterize dust and revise HASP

6.3.5 Conditions Warranting Upgrade to Level B Protective Equipment

- Sustained PID or OVA readings for 5 minutes that exceed 5 ppm
- Screening of the exclusion zone with compound-specific Draeger tubes indicates concentrations of chemicals in the breathing zone that exceed the capacity of a full-face respirator
- Any detectable concentrations of acrylonitrile
- Any detectable concentrations of benzene
- Any detectable concentrations of vinyl chloride

6.3.6 Conditions Warranting Cessation of Work and Leaving Area Immediately (notify Health and Safety Officer):

- Emergency signal is given
- Excessively dust conditions
- Sustained PID or OVA readings of 5 ppm above background in breathing zone for 5 minutes
- Member of field team experiences symptoms possibly related to chemical exposure such as dizziness or nausea, or heat/cold stress (see Attachment B)
- Any monitoring equipment malfunctions; work may resume once the instruments are in working order

6.3.7 Activity-Specific Hazards:

- Potential dermal contact with soil or exposed wastes.
- Inhalation hazard related to escaping soil gas

Skin will be protected wearing protective outer clothing. The buddy system will be used at all times.

6.4 ACTIVITY-SPECIFIC REQUIREMENTS FOR DECONTAMINATION

Procedures to be followed to decontaminate equipment are described in SOP-14.

6.4.1 Personnel and Equipment Decontamination

Decontamination of personnel and equipment will be performed to limit the transport of contaminants to personnel, to off-site areas, and between work areas. All sampling equipment coming in contact with soils, sediment, groundwater and surface water will be decontaminated prior to sampling, between sampling locations, between boring intervals, and at the completion of work. The objective of the procedure is to minimize the potential for cross-contamination of samples and accumulation of erroneous data.

Decontamination equipment and supplies consist of the following:

- Potable water
- 5 gal buckets

- Wash tubs
- Alconox (or equivalent)
- Scrub brushes
- Hot water or high pressure sprayer
- Garbage bags
- Distilled water
- Hand spray bottle
- Plastic sheeting
- Saw horses or pallets

Decontamination of heavy equipment will occur in the main decontamination area. This area will be established for cleaning of augers, drill bits, drill rig, backhoe, large tools, and other large items.

Personnel and small sampling and field equipment decontamination may be performed outside the sampling locations or at the main decontamination area.

Small equipment will be cleaned using the following equipment procedures:

- Scrub with brush using Alconox soap (or equivalent) and potable water solution
- Water rinse
- Air dry
- Place sampling equipment into new plastic bags (if necessary to store)

Large equipment will be decontaminated using procedures outlined below.

- Move equipment to designated area.
- Clean equipment using a high pressure or hot water wash. Scraping and scrubbing may be necessary to remove encrusted material. Items should be placed on saw horses or pallets to prevent contact with the ground.
- Place equipment on saw horses or pallets and allow to dry; protect against airborne dust or spray water cross-contamination.
- Decontaminated equipment (augers, drill rods, and associated equipment) will be stored in a clean designated area.
- Sampling and field equipment should not come in contact with potential sources of contamination prior to moving to the next sample location.

Personnel will be decontaminated using procedures outlined below:

- Discard disposable PPE at the decontamination station when leaving the exclusion zone
- If PPE is reusable, scrub PPE (e.g., boots) with brush using Alconox soap (or equivalent) and potable water solution
- Water rinse
- Air dry

7.0

HEALTH SURVEILLANCE PROGRAM

All ESE and BASF employees and contractors involved with this project work will participate in a health surveillance program under the direction of an Occupational Physician. This program includes an annual medical evaluation. The Annual health evaluation consists of the following:

- Comprehensive health and exposure history,
- Physical evaluation,
- Urinalysis,
- SMAC 24 including total cholesterol and high density lipoprotein and GGTP,
- Complete blood count (CBC), differential, hematocrit, and hemoglobin,
- Chest x-ray (every 3rd year),
- Pulmonary function testing,
- Audiometry,
- Vision testing (distant, near, color),
- Cholinesterase (ESE personnel only)

Additionally, each employee will be evaluated to determine if they are physically able to perform work while wearing respiratory protective equipment in compliance with 29 CFR Part 1910.134.

ESE will maintain a regular health surveillance program for all project employees. ESE will require equivalent health surveillance for all of its on-site subcontractor employees. The SSO will be responsible for maintaining a health and safety file for all on-site employees that will include 40-hour hazardous waste operations training certificate and refreshers, respirator fit test record, 3 day on-site training record, health and safety plan compliance statement and medical restriction assessment from an occupational physician. BASF personnel health and safety records are maintained by BASF.

8.0
AIR MONITORING PROTOCOL

Air monitoring for site characterization activities will be accomplished with the following equipment:

Type	Frequency	Gas Standard
Photoionization Detector	During field activities calibrate once/day	Isobutylene
Organic Vapor Analyzer (OVA)	During field activities calibrate once/day	Methane
Draeger Tubes and Pump	During field activities as needed	Compound-specific tubes
Ram One or Mini Ram	When visible dust can't be controlled by dust-wetting	

Calibration procedures will follow manufacturers' instructions. Attachment C contains instruction manuals and records will be maintained in accordance with Section 13.0.

9.0
SITE CONTROL

This section describes how entry and exit between the exclusion zone and the decontamination zone at the Site is controlled. Compliance with these site-control procedures will prevent cross-contamination or contamination of samples and protects the health and well being of all field personnel. Details of site-control measures are also presented in the Health and Safety Plan.

The ESE's Site Safety Officer (SSO) will brief field personnel and contractors regarding the known site hazards, exposure pathways (dermal contact and ingestion of contaminated soils, sediment, sludges, and inhalation of airborne particulates), local medical emergency facilities, and site evacuation procedures. The SSO also ensures that all field sampling personnel have completed applicable health and safety training requirements. Certificates of training for all site personnel will be maintained in the project files (OSHA 1910.120(e)). All personnel will be provided with a site map, buddy system, and the requirements for reporting/documentation of non-compliance. Daily notation of site surveillance control activities must be entered by the SSO.

A personnel decontamination station will be set up so that all personnel entering and leaving work areas are decontaminated. Samples will be stored temporarily in coolers located in a pre-designated space until the samples are packaged and shipped to the receiving laboratories.

An equipment decontamination zone will be established for each major sampling task area. Potable water, deionized or distilled water, Alconox, or other appropriate decontamination supplies will be provided in each decontamination zone.

10.0
STANDARD OPERATING PROCEDURES

10.1 PERSONAL PRECAUTIONS

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated work area.
- Hands and face must be thoroughly washed upon leaving the work area.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
- No facial hair which interferes with a satisfactory fit of the mask-to-face-seal is allowed on personnel who may be required to wear respirators.
- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, discolored surfaces, kneel on ground, lean, site or place equipment on drums, containers, or the ground.
- Medicine and alcohol potentially can enhance the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel at hazardous waste operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Alcoholic beverages are prohibited on site, and their use is prohibited during work hours.
- All personnel must be familiar with standard operating safety procedures and any additional instructions and information contained in the Health and Safety Plan.
- All personnel must adhere to the information contained in the Health and Safety Plan.
- Contact lenses cannot be worn while on BASF property.
- Personnel will be made aware of symptoms for toxic chemicals on site and for heat or cold stress.
- Respirators shall be cleaned and disinfected after each day's use or more often if necessary.

- Prior to donning, respirators will be inspected for worn or deteriorated parts according to the respiratory protection program.

- Employees will be familiar with all sections of the established respiratory protection program.

10.2 OPERATIONS

- All personnel going on-site must be adequately trained and thoroughly briefed on anticipated hazards, equipment to be worn, safety practices to be followed, emergency procedures, and communications.

- Any required respiratory protective devices and clothing must be worn by all personnel going into areas designated for wearing protective equipment.

- Personnel on-site must use the buddy system when entering a designated exclusion zone. As a minimum, two (2) backups are required during extremely hazardous entries.

- Visual contact must be maintained between pairs on-site (i.e. the buddy system) and safety personnel. Entry team members should remain close together to assist each other during emergencies.

- Personnel should practice unfamiliar operations prior to doing the actual procedure.

- Entrance and exit locations must be designated and emergency escape routes delineated. Warning signals for site evacuation shall be established.

- Communications using radios, hand signals, or other means must be established for entry into any designated exclusion zone. Emergency communications should be prearranged in case of radio or cellular phone failure, necessity for evacuation of site, or other reasons.

- Personnel and equipment in contaminated areas shall be minimized, consistent with effective site operations.

- Work areas for various operational activities must be established.

- Procedures for leaving a contaminated area must be planned and implemented prior to going on-site. Work areas and decontamination procedures must be established based on expected site conditions, and periodically evaluated based on subsequent findings.

- Frequent and regular inspections of site operations by the SSO will be conducted to ensure compliance with the Health and Safety Plan. If any changes in operation occur, the Health and Safety Plan must be modified to reflect changes.

- All electrical equipment (power tools, extension cords, instruments, radios, etc.) shall conform to the appropriate section in OSHA 29 CFR 1926.400 Subpart K or the existing area electrical classifications.

- BASF allows smoking only in permanent, designated smoking areas.

- "Hot Work" permits are required on a daily basis from BASF Construction Services.

- Fire prevention and protection (appropriate signs for flammable liquids, designated smoking areas, storage areas of combustible or flammable materials, etc.) shall be in accordance with OSHA 29 CFR 1926.150 Subpart F.

11.0
CONTINGENCY PLAN

11.1 EMERGENCY PROCEDURES

The SSO will be responsible for emergency response at the site. In the event of an emergency, the following telephone numbers will be utilized. Prior to initiating site activities, the location of the telephone closest to the site will be located or a mobile telephone will be used.

11.2 EMERGENCY TELEPHONE NUMBERS

Name	Telephone No.
BASF Security Office	(313) 246-6400
BASF Medical Clinic	(313) 246-6443
BASF Emergency	(313) 246-6209
BASF Safety Coordinator	(313) 246-6209
ESE Project Manager	(517) 655-4391
ESE Local Health & Safety Representative	(517) 655-4391
ESE Corporate Health & Safety Director	(603) 672-2511
Ambulance: Superior Ambulance	(800) 552-4930
Fire Department:	911
Wyandotte Police Department:	911
Wayne Co. Sheriff	911
Hospital: Wyandotte General	(313) 246-6000
Poison Control	(313) 745-5711

11.3 EMERGENCY EQUIPMENT

The safety equipment on-site includes the following items which will be placed in the support vehicle.

First Aid Kit - All medical supplies shall comply with 29 CFR 1926.50
Eye/hand wash kit
Fire extinguisher
Life rings and safety lines

11.4 EVACUATION ROUTE(S)

A vehicle should be parked near each location where drilling or sampling is occurring; it should face the closest exit. Upon arrival at the site, the SSO will determine all possible evacuation routes and review these with field personnel during on-site briefing and periodically thereafter. The SSO will also drive the hospital route prior to commencement of site work.

11.5 HOSPITAL ROUTE

Wyandotte General Hospital is the first building south of the BASF facility. Exit BASF main gate, turn left, proceed south on Biddle Avenue and turn left into Hospital.

11.6 EMERGENCY SIGNAL

The use of emergency signals (i.e., hand, arm movements) during field work may be necessary if communicative abilities are reduced due to excessive noise or injury. Signals are to be reviewed by SSO at the initial on-site briefing and periodically thereafter.

11.7 EMERGENCY PROCEDURES WITHIN EXCLUSION ZONE

Decontamination of personnel will be as thorough as possible.

If a potentially serious or life threatening incident occurs within the exclusion zone, assistance to the injured person and removal to a hospital shall take precedence over personal decontamination.

12.0

EMPLOYEE HEALTH AND SAFETY COMPLIANCE AGREEMENT

I, the undersigned, have received a copy of the Health and Safety Plan identified below. I have read the plan, understand it, and agree to comply with all of the health and safety directives. I have attended a site briefing given by the Site Safety Officer or Health and Safety Officer. I understand that I may be prohibited from working on the project for violating any of the directives.

Project No:

Site Name: BASF Corporation North Works

Print Name:

Firm:

Signature:

Date:

Name	Company	Project Function

Contractors:

13.0 DOCUMENTATION

Implementation of the provisions of this Health and Safety Plan will be documented. The SSO will set up a separate file to receive health and safety related records and activity reports. This file will contain the following records:

1. Copies of subcontractor and "Employee Health and Safety Compliance Agreement" (Section 12.0) documenting health and safety briefings and personnel signatures,
2. Copies of safety equipment operation manuals,
3. Records of usage and calibration of environmental monitoring equipment,
4. Employee injury/exposure incidents reports (Attachment A),
5. Records of safety violation and remedial actions taken, and
6. Documentation of contractors' compliance with requirements for health and safety training and medical monitoring.

A health and safety field logbook will be maintained on site and will contain such information as: weather conditions, employees and visitors on site, level of personal protection worn, calibrations, monitoring instrument readings (average, peak, and background), and subjects discussed during site health and safety briefings and names of attendees.

All field personnel, including subcontractors, will sign the Employee Health and Safety Compliance Agreement indicating that they have attended a briefing by the SSO, and that they understand and agree to abide by the provisions of this HSP, prior to working at the site.

14.0

OPERATING PROCEDURE NO. HS-502

All health and safety incidents that occur during field and laboratory activities associated with investigations and remediation of sites containing hazardous materials must be reported to management.

Definitions

A health and safety incident is any event listed below:

- Illness resulting from chemical exposure or unknown causes.
- Physical injury, including those that do not require medical attention.
- Fire, explosions, and flashes resulting from activities performed by ESE and its subcontractors.
- Property damage resulting from activities performed by the ESE and its subcontractors.
- Vehicular accidents occurring on-site or while travelling to and from sites.
- Infractions of safety rules and requirements.
- Unexpected chemical exposures (indicated by irritation of eyes, nose, throat, or skin).
- "Near Misses" in any of the above items.

Reporting Format

Incident reports shall be prepared by completing the BASF Accident/Incident Report Form (Attachment A).

Responsible Party

Reports of incidents occurring in the field shall be prepared by the site safety officer, or in the absence of the site safety officer, the supervising field engineer, witness, or injured/exposed individual.

Filing

A report must be submitted to BASF Safety Coordinator and the ESE Health and Safety Officer of the business unit to which the project manager belongs within 24 hours of each incident.

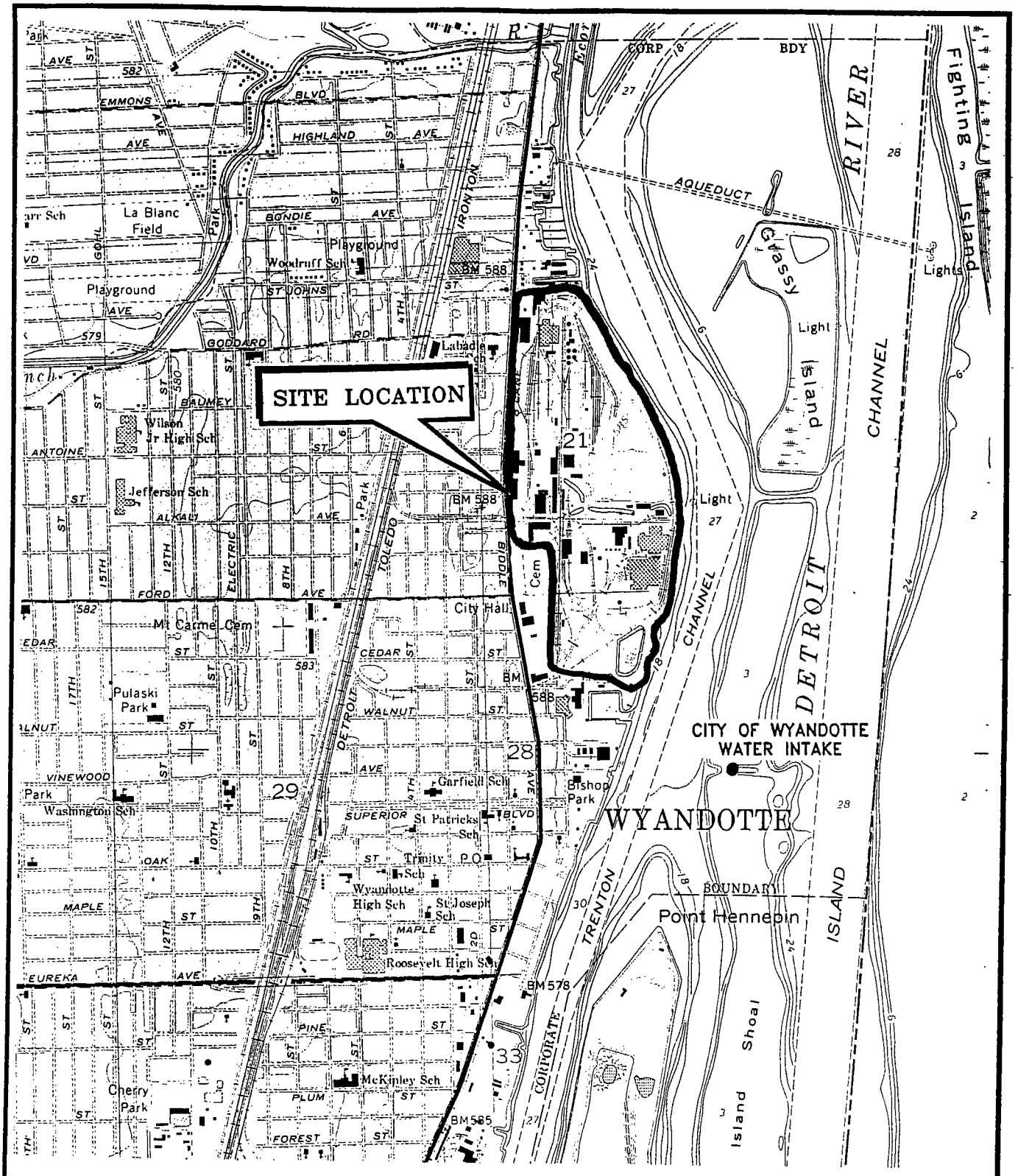
TABLE A
COMPOUNDS IDENTIFIED IN SOIL OR GROUNDWATER
DURING 1981 INVESTIGATION

Aniline
Acrylonitrile
Aminoethylcarbonate
Anthracene
Acenaphthylene
Benzene
Benzoic Acid
bis (2-Chloroisopropyl) phthalate
bis (Ethylhexyl) adipate
Benzofuran
Benzo (k) flouranthene
Benzo (a) pyrene
bis (Ethylhexyl) phthalate
Chloroform
Chlorocresol
Cadmium
Cresol
Chromium
Chrysene
Copper
2,4 Dimethylphenol
Decanoic Acid
Dichloropropane
Dichlorophenol
Diethylphthalate
2,3 Dihydroindene
Dimethylbenzylbenzene
Dimethylbiphenyl
Dimethyethylbenzene
Dimethylmethoxybenzofuran
Dimethylnaphthalene
Dioctylphthalate
Diphenylsulphone
Dimethylphenol
Ethylbenzene
2-Ethylhexanol
Ethylpyridine
Fluorene
Fluoranthene
Hexachlorobutadiene
Indene
Indane
Isopropylbenzene
Methylanaline
Methylene Chloride
Methylnaphthalene
Methylphenylacetylene
Methylstyrene
2-Methylthiophene
Naphthalene
Nonylphenol
Pyrene
Phenyl Acetic Acid
Lead
Pyridine
Phenyl Ethyl Acetic Acid
Phenol
Phenanthrene
Styrene
Toluene
Trichlorobenzene
Tetrachlorobutadiene
Toluenediamine
Trimethylbenzene
Tetramethylsuccimonitrite
Thiophene
Xylene
Xanthene
Zinc

TABLE B
EXPOSURE LIMITS FOR POTENTIAL CHEMICAL HAZARDS
NORTH WORKS FACILITY, WYANDOTTE, MICHIGAN

Chemical Name	Ionization Potential eV	Time Weighted Average Concentration (mg/m3) (OSHA unless noted)	Short Term Exposure Limit Concentration (mg/m3) (OSHA unless noted)
Benzene	9.24	3.3 (1)	16.25 (5)
Acrylonitrile	10.91	4.4 (2)	22.1 (1) C
Aniline	7.7	19 (5)	-
Benzo(b)fluoranthene	-	0.2	-
Benzo(a)pyrene	-	0.2	-
Chloroform	11.42	9.9 (2)**	240 (50) C
Chrysene	-	0.2	-
Dichloroethyl ether	-	30 (5)**	90 (15) C
1-2, dichloropropane	10.87	350 (75)	510 (110)
Fluoranthene	-	0.2	-
Hexachlorobutadiene	-	0.02*	-
Methlylene chloride	11.32	1765 (500)	3530 (1000) C
Trichloroethene	9.45	550 (100)	1100 (200) C
Chlorobenzene	9.07	3600 (75)	-
p-choloro-m-cresol	8.98	22 (5)	-
Cresol	8.98	22 (5)	-
Dichlorophenol	-	-	-
Diethyl phthalate	-	-	-
2,4 dimethyl phenol	-	-	-
Fluorene	-	0.2	-
Naphthalene	8.12	50 (10)	75 (15)
Phenol	8.50	19 (5)	-
Phthalic acid ester	-	-	-
Pyridine	9.27	15 (5)	-
Toluene	8.82	765 (200)	1150 (300) C
1,2,3 trichloropropane	-	300 (50)	-
Styrene	8.40	430 (100)	860 (200) C

- = not listed
mg/m3 = milligrams per cubic meter of air
(2) = parts per million in air
C = ceiling concentration
* = American Conference of Governmental Industrial Hygienists
** = National Institute for Occupational Safety and Health
eV = electron volts

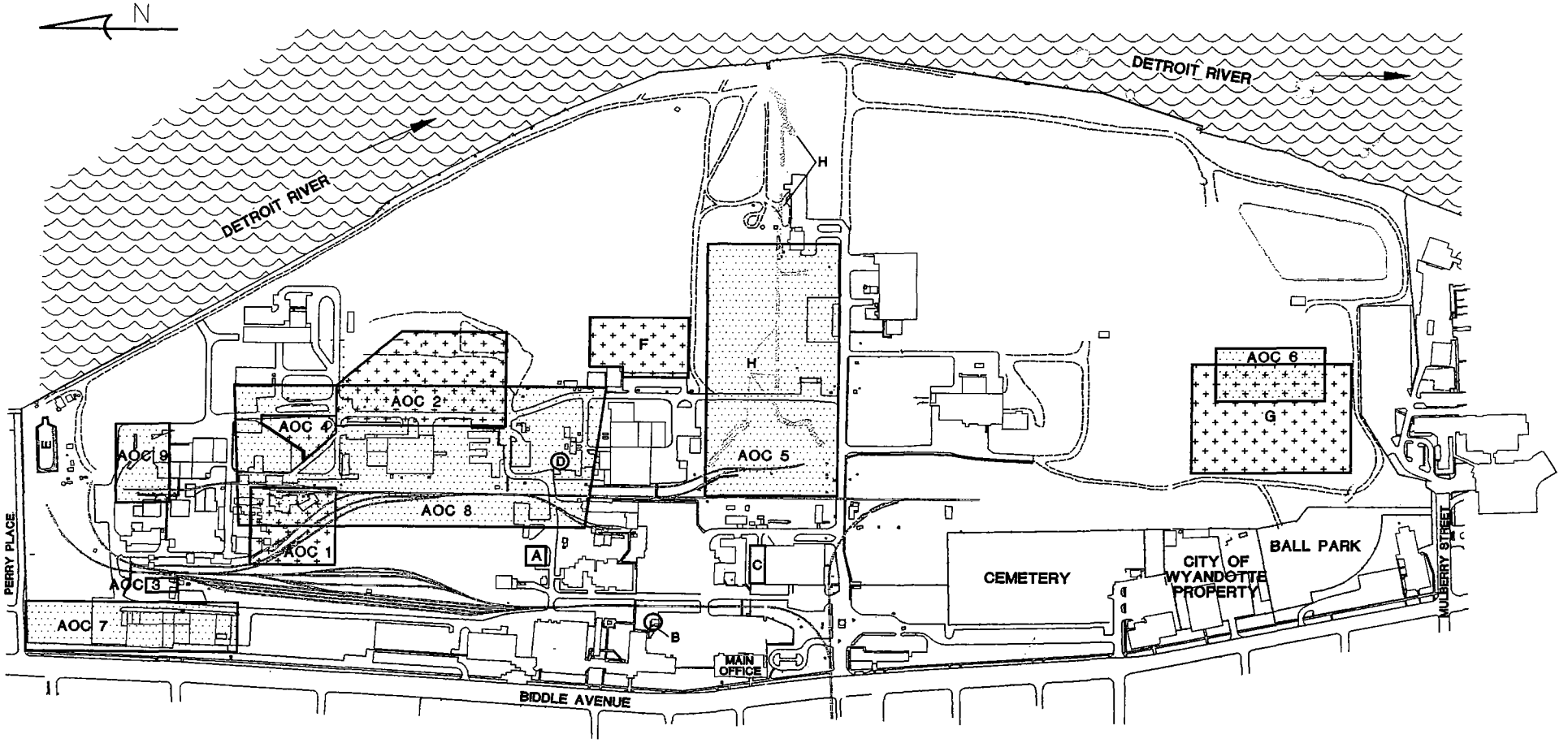


[ACAD]\DWG\STAN_SITEMAP

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

BASF CORPORATION
WYANDOTTE, MICHIGAN
SITE LOCATION MAP

DESIGN: –	CHK'D: JL	PROJECT NO. 4E07014	FIG. NO. 1
DRAWN: DAS	DATE: 6/21/94		

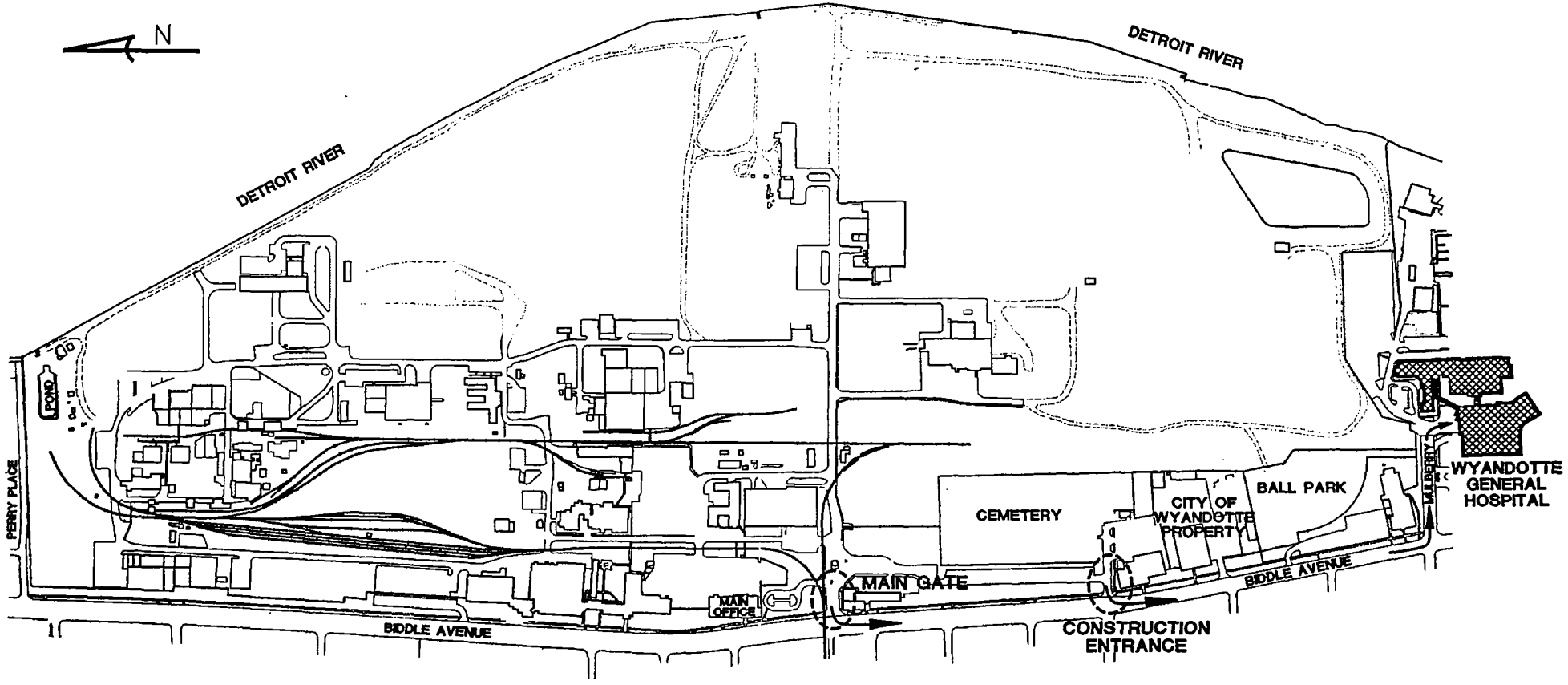


Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

BASF CORPORATION
WYANDOTTE, MICHIGAN
LOCATIONS OF
SWMUs AND AOCs

DESIGN: JL	CHK'D: MMc	PROJECT NO. 4E07014	FIG. NO. 2
DRAWN: DAS	DATE: 3/25/96		

LOCATIONS.DWG/LAYOUT1



ROUTE TO HOSPITAL

SOUTH (LEFT) ONTO BIDDLE AVE.
EAST (LEFT) AT MULBERRY STREET

0 400 800
SCALE IN FEET

Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

BASF CORPORATION
WYANDOTTE, MICHIGAN
HOSPITAL EMERGENCY ROUTE
AND SITE FEATURES

DESIGN	JL	CHK'D		PROJECT NO.	FIG. NO.
DRAWN	DAS	DATE	5/20/94	4E07014	3

ATTACHMENT A

BASF ACCIDENT/INCIDENT REPORT FORM

Accident/Incident Investigation Form

BASF Corporation

BASF

Name Last	First	Initial	Incident Date	Date Reported	Division Code

Site	Plant	Incident Location	Incident Time

Job Title	Supervisor	Occupational ☐ Non-occupational ☐	Undetermined ☐ Precautionary ☐

How did incident occur?

Classification:

- ☐ 1. First Aid
- ☐ 2. Medical
- ☐ 3. Restricted Duty
- ☐ 4. Days Away From Work
- ☐ 5. Near Miss
- ☐ 6. Fire
- ☐ 7. Contractor
- ☐ 8. Overexposure
- ☐ 9. Illness
- ☐ 10. Spill
- ☐ 11. Release
- ☐ 12. Property Loss
- ☐ 13. Permit Excursion
- ☐ 14. Off-Site
- ☐ 13. Other

Complete Reverse Side.

Chemical or substance involved:	Exposure above I.H. Limit Value:
Amount discharged to air:	CERCLA or SARA reportable quantity exceeded?
Amount discharged to land:	Agencies notified:
Amount discharged to sewer:	Disposition of material:

Describe injury/property loss:

Estimated cost of property loss:	Estimated remedial cost:

How did it happen?

Immediate corrective action(s):

Corrective action(s) to prevent recurrence:	Responsibility	Target Date

Investigator/Employee	Date	Supervisor	Date
Safety & Loss Prevention	Date	Department Head	Date
Ecology	Date	Plant/Site Manager	Date

F7026 Rev 3/92
SA-20-003

Instructions

Complete all sections on the front page. The Accident/Incident Investigation Report is not complete until the appropriate signatures are obtained.

Copies of all injury and illness investigations, except first aids, must be sent to Corporate Safety and Loss Prevention and environmental incident investigations to Regional Ecology.

This investigation is "open" until corrective action has been completed.

The following is for the purpose of maintaining computerized Statistics. Complete each block "A" through "V" using the appropriate code number assigned for each entry from the data below.

When applicable, complete the below section for number of restricted days and/or number of days away from work.

Industrial Injuries Code

A.		Employee Soc. Sec. No.	M.		Time in that job
B.		SIC Code	N.		Accident type
C.		Division	O.		Accident agency
D.		Site	P		Nature of
E.		Plant	Q.		Body part affected
F.		Age	R.		Primary cause
G.		Sex	S.		Contrib. cause
H.		Hours Worked	T.		Contrib. cause
I.		Overtime	U.		Contrib. cause
J.		Employee Status	V.		Unsafe act/condition
K.		Occupation			
L.		Time Employed			

Number of restricted days: _____ Final ☐ Est. ☐

Number of days away from work. _____ Final ☐ Est. ☐

A Employee Social Security Number

B. SIC code

C. Division

NC-Chemicals	NV-Consumer Products & Life Science
NP-Polymers	NF-Fibers
NL-Coatings & Colorants	NH/NT/NOE-Corporate Finance and Services
	BCI-BASF Canada Inc.

D. Site Site Code

E Plant Plant Code

F. Age
Age in years at time of incident

G Sex
M-Male F-Female

H. Hours worked before incident

01-1	04-4	07-7	10-10	13- >12
02-2	05-5	08-8	11-11	
03-3	06-6	09-9	12-12	

I. Overtime
Y - Yes N - No

J. Employee status

1-Reg. full-time	3-Temporary
2-Reg. part-time	4-Non-employee

K. Occupation
1-Warehouse, shipping & receiving
2-Production/utilities worker
3-Maintenance/construction worker
4-Plant services, janitors, guards
5-Vehicle driver
6-Foreman/Supervisor
7-Lab-QC, R&D & pilot plant
8-Sales, marketing, techincal services
9-Administrative, clerical

L. Time employed, years

01-less than 1	04-10-20
02-1 to 5	05- >20
03-5 to 10	

M. Time in that job, years

01-less than 1	04-10 to 20
02-1 to 5	05- >20
03-5 to 10	

N. Accident type
01-Fall from elevation
02-Fall, same level
03-Slip or trip without fall
04-Struck against object
05-Struck by object
06-Caught in, under, between
07-Overexertion, strain
08-Public or contracted transportation
09-Motor vehicle (employee's or company's)
10-Drowning, buried
11-Explosion, implosion
Contact by:
12-Chemicals
13-Electricity
14-Temperature extremes
15-Noise
16-Radiation
17-Other physical agents
18-Animal, insect, plant

O. Accident agency/involved equipment
01-Fired vessels-boiler, incin., etc.
02-Reactors, columns,vessels, etc. >15 psig
03-Process eqpt. tanks, bins <15 psig
04-Gas or liquid handling (into)
05-Solids handling (into)
06-Mechanical power transmission-gears, couplings, belts, pulleys
07-Portable eqpt. machinery
08-Hoists, cranes, etc.
09-Over-the-road automobiles, and trucks, incl. tank trucks
10-Industrial trucks, forklifts, end loaders, tractors, bicycles
11-Railroad, rolling stock, incl. tank cars
12-Piping, hoses, valves and fittings
13-Containers-drums, boxes, pails, cylinders etc.
14-Ladders, scaffold
15-Floors, working/walking surfaces
16-Tools-hand (wrenches, etc.)
17-Knives, scissors
18-Tools-powered (elec., air, etc.)
19-Electrical distrib. sys./apparatus
20-Office equipment
21-Laboratory equipment
22-Fabrication, assembly or machine shop equipment
23-Chemicals
24-Hot liquids/gas
88-Other
99-Unknown

P. Nature of injury/illness
01-Amputation, avulsion
02-Fracture, dislocate, crush
03-Cut, scrape, puncture, sting bite
04-Bruise, contusion
05-Irritation
06-Hernia, rupture
07-Sprain, strain
08-Burn-chemical
09-Burn-thermal or electrical
10-Heat stress, exhaustion, sunstroke,
11-Suffocate, drown, asphyxiate (lack of oxygen)
12-Concussion, unconscious
13-Poisoning-acute
14-Other
21-Skin disease or disorder
22-Dust disease of the lung
23-Respiratory-toxic agents
24-Poisoning-chronic
25-Physical agents-radiation, etc.
26-Repeated trauma-noise, etc
29-Other illness, heart cont., etc.
00-No injury

Q. Body part affected
10-Head
11-Eye(s)
12-Ear(s)
13-Face
14-Neck
20 Trunk, Torso
21-Shoulder
22-Chest
23-Back, spine
24-Abdomen, groin
25-Hip
30-Upper Extremeties
31-Upper arm
32-Elbow
33-Forearm
34-Wrist
35-Hand
36-Finger(s)
40 Lower Extremities
41-Thigh
42-Knee
43-Shin, calf
44-Ankle
45-Foot
46-Toe(s)
50-Body Systems
51-Circulatory
52-Respiratory
53-Neurological
54-Reproductive
00-No body part injured

R.-U. Causal factors (primary and contributory causes)
Supervision
10-Incorrect/incomplete procedures, instructions
11-Rules, procedures, work methods not enforced
12-Inadequate training of employee(s)
13-Proper tools, equipment not provided
14-Deficient storage/material handling practices
15-Inadequate housekeeping, area inspections
16-Too much rush on job by supervisor

Employee
20-Physical limitation
21-Deficient in skill or ability
22-Influence of drugs or alcohol
23-Lack of alertness
30-Failure to follow written procedures or rule
31-Confined space entry procedure
32-Hot work procedure
33-Line breaking procedure
34-Lockout/tagout procedure
35-Maintenance, adjustment or cleaning on moving/pressurized equipment/line
40-Failure to follow oral instructions
50-Failure to use personal protective equipment
51-Operating without authority
52-Taking an unsafe position
53-Unsafe speed, haste, short cut
54-Improper use of tool, equipment, material
55-Use of incorrect tool/equipment/material
56-Improper manual material handling

Equipment
60-Defective equipment, tool material
61-Inadequate or missing guards
62-Inadequate or bypassed safety devices
63-Inadequate maintenance, equipment inspections
64-Inadequate lighting
65-Inadequate ventilation
66-Inadequate design/layout (congestion)
67-Inadequate fabrication/installation

Environment
70-Horseplay/distraction by fellow employee
71-Error by fellow employee
72-Unsafe eqpt./matl's./actions of 3rd party
73-Upset conditions-fire/explosion/spill, etc
74-Exposure to chem./phys./biological agents
75-Weather-rain, snow, ice, wind, etc.
99-No other causes

V. Unsafe act/condition
1-Unsafe act 2-Unsafe condition

ATTACHMENT B

IDENTIFICATION AND PREVENTION OF HEAT STRESS

201.0 HEAT STRESS

201.1 PURPOSE

The purpose of this Operating Procedure is to provide general information on heat stress and the methods that can be utilized to prevent or minimize the occurrence of heat stress.

Adverse climatic conditions are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability. Heat stress is of particular concern while wearing impermeable protective garments, since these garments inhibit evaporative body cooling.

201.2 TYPES OF HEAT STRESS

Heat stress is the combination of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental factors of heat stress are the air temperature, radiant heat exchange, air movement, and water vapor pressure. Physical work contributes to the total heat stress of the job by producing metabolic heat in the body in proportion to the intensity of the work. The amount and type of clothing also affects heat stress.

Heat strain is the series of physiological responses to heat stress. When the strain is excessive for the exposed individual, a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Heat disorder is a general term used to describe one or more of the heat-related disabilities or illnesses shown in Table 201-1.

201.3 METHODS OF CONTROLLING HEAT STRESS

As many of the following control measures, as appropriate, should be utilized to aid in controlling heat stress:

- Provide for adequate liquids to replace lost body fluids. Encourage personnel to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.

- Replace body fluids primarily with water, with commercial mixes such as Gatorade or Quick Kick used only as a portion of the replacement fluids. Avoid excessive use of caffeine drinks such as coffee, colas or tea.

- Establish a work regimen that will provide adequate rest periods for cooling down. The heat exposure Threshold Limit Values (TLV) may be used for guidelines.

- Provide shaded work areas, if possible.

- Wear cooling devices such as vortex tubes or cooling vests.

- Consider adjusting work hours to avoid the worst heat of the day.

- Take breaks in a cool rest area.

- Remove any impermeable protective garments during rest periods.

- Do not assign other tasks to personnel during rest periods.

- Inform personnel of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

201.6 MONITORING

201.6.1 Temperature

The environmental heat stress of an area can be monitored by the Wet Bulb Globe Temperature Index (WBGT) technique. When heat stress is a possibility, a heat stress monitoring device, such as the Wibget Heat Stress Monitor (Reuter Stokes) can be utilized.

The WBGT shall be compared to the TLV outlined by the American Conference of Governmental Industrial Hygienists (ACGIH) TLV guides, and a work-rest regiment can be established in accordance with the WBGT. Note that approximately 5°C must be subtracted from the TLVs listed for heat stress to compensate for the wearing of impermeable protective clothing.

201.6.2 Medical

In addition to the provisions of the Woodward-Clyde (W-C) medical surveillance program, on-site medical monitoring of personnel should be performed for projects where heat stress is a significant concern. Blood pressure, pulse, body temperature (oral), and body weight loss may be utilized.

Heart Rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third. If the heart rate still exceeds 110 beats per minute at the next rest cycle, shorten the following work cycle by one-third.

Oral Temperature: Use a clinical thermometer or similar device to measure the oral temperature at the end of the work period (before drinking liquids). If the oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

Do not permit a worker to wear a semipermeable or impermeable garment if his/her oral temperature exceeds 100.6°F (38.1°C).

Body Water Loss: Measure body weight on a scale accurate to $\pm$0.25 pounds at the beginning and end of each work day (also at lunch break, if possible) to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day.

Physiological Monitoring: Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of the work cycle will be governed by the frequency of the required physiological monitoring.

201.7 REFERENCES

American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents, 1992-1993.

EPA, Standard Operating Safety Guides, 1992, Pages 91-93.

National Institute for occupational Safety and Health, Criteria for a Recommended Standard: Occupational Exposure to Hot Environments, 1986.

TABLE 201-1
Classification, Medical Aspects, and Prevention of Heat Illness

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbances	Treatment	Prevention
Temperature Regulation Heatstroke				
Heatstroke: (1) Hot, dry skin; usually red, mottled, or cyanotic; (2) rectal temperature 40.5°C (104°F) and over; (3) confusion, loss of consciousness, convulsions, rectal temperature continues to rise; fatal if treatment is delayed	(1) Sustained exertion in heat by unacclimatized workers; (2) lack of physical fitness and obesity; (3) recent alcohol intake; (4) dehydration; (5) individual susceptibility; and (6) chronic cardiovascular disease	Failure of the central drive for sweating (cause unknown) leading to loss of evaporative cooling and an uncontrolled accelerating rise in t_{re}; there may be partial rather then complete failure of sweating	Immediate and rapid cooling by immersion in chilled water with massage or by wrapping in wet sheet with vigorous fanning with cool dry air; avoid overcooling; treat shock if present	Medical screening of workers, selection based on health and physical fitness; acclimatization for 5-7 days by graded work and heat exposure; monitoring workers during sustained work in severe heat
Circulatory Hypostasis Heat Syncope				
Fainting while standing erect and immobile in heat	Lack of acclimatization	Pooling of blood in dilated vessels of skin and lower parts of body	Remove to cooler area; rest in recumbent position; recovery prompt and complete	Acclimatization; intermittent activity to assist venous return to heat
Water and or Salt Depletion				
(a) Heat Exhaustion (1) Fatigue, nausea, headache, giddiness; (2) skin clammy and moist; complexion pale, muddy, or hectic flush; (3) may faint on standing with rapid thready pulse and low blood pressure; (4) oral temperature normal or low, but rectal temperature usually elevated (37.5-38.5°C or 99.5-101.3°F); water restriction type: urine volume small, highly concentrated; salt restriction type; urine less concentrated chlorides less than 3 g/L	(1) Sustained exertion in heat; (2) lack of acclimatization; and (3) failure to replace water lost in sweat	(1) Dehydration from deficiency of water; (2) depletion of circulating blood volume; (3) circulatory strain from competing demands for blood flow to skin and to active muscles	Remove to cooler environment; rest in recumbent position; administer fluids by mouth; keep at rest until urine volume indicates that water balances have been restored	Acclimatize workers using a breaking-in schedule for 5-7 days; supplement dietary salt only during acclimatization; ample drinking water to be available at all times and to be taken frequently during work day
(b) Heat Cramps Painful spasms of muscles used during work (arms, legs, or abdominal); onset during or after work hours	(1) Heavy sweating during hot work; (2) drinking large volumes of water without replacing salt loss	Loss of body salt in sweat, water intake dilutes electrolytes; water enters muscles, causing spasm	Salted liquids by mouth or more prompt relief by IV infusion	Adequate salt intake with meals; for unacclimatized workers, supplement salt intake at meals.

TABLE 201-1 (continued)
Classification, Medical Aspects, and Prevention of Heat Illness

Category and Clinical Features	Predisposing Factors	Underlying Physiological Disturbances	Treatment	Prevention
Skin Eruptions				
(a) Heat Rash (miliaria rubra, or "prickly heat") Profuse tiny raised red vesicles (blisterlike) on affected areas; prickling sensations during heat exposure	Unrelieved exposure to humid heat with skin continuously wet from unevaporated sweat	Plugging of sweat gland ducts with sweat retention and inflammatory reaction	Mild drying lotions; skin cleanliness to prevent infection	Cool sleeping quarters to allow skin to dry between heat exposures
(b) Anhidrotic Heat Exhaustion (miliaria profunda) Extensive areas of skin which do not sweat on heat exposure, but present gooseflesh appearance, which subsides with cool environments; associated with incapacitation in heat	Weeks or months of constant exposure to climatic heat with previous history of extensive heat rash and sunburn	Skin trauma (heat rash; sunburn) causes sweat retention deep in skin; reduced evaporative cooling causes heat intolerance	No effective treatment available for anhidrotic areas of skin; recovery of sweating occurs gradually on return to cooler climate	Treat heat rash and avoid further skin trauma by sunburn; provide periodic relief from sustained heat
Behavioral Disorders				
(a) Heat Fatigue - Transient Impaired performance of skilled sensorimotor, mental, or vigilance tasks, in heat	Performance decrement greater in unacclimatized and unskilled worker	Discomfort and physiologic strain	Not indicated unless accompanied by other heat illness	Acclimatization and training for work in the heat
(b) Heat Fatigue - Chronic Reduced performance capacity; lowering of self-imposed standards of social behavior (e.g., alcoholic over-indulgence); inability to concentrate, etc.	Workers at risk come from temperature climates for long residence in tropical latitudes	Psychosocial stresses probably as important as heat stress; may involve hormonal imbalance but no positive evidence	Medical treatment for serious causes; speedy relief of symptoms on returning home	Orientation on life in hot regions (customs, climate, living conditions, etc.)

ATTACHMENT C

PHOTOIONIZATION DETECTOR (PID) AND ORGANIC VAPOR ANALYZER OVA

PHOTOIONIZATION DETECTOR

The instrument is turned on to check the battery. The instrument is then allowed to warm up for about five minutes. The calibration gas (usually isobutylene) is attached per the calibration test set up diagram (attached). The proper range setting is selected (usually 0 to 200 ppm) and the calibration gas turned on.

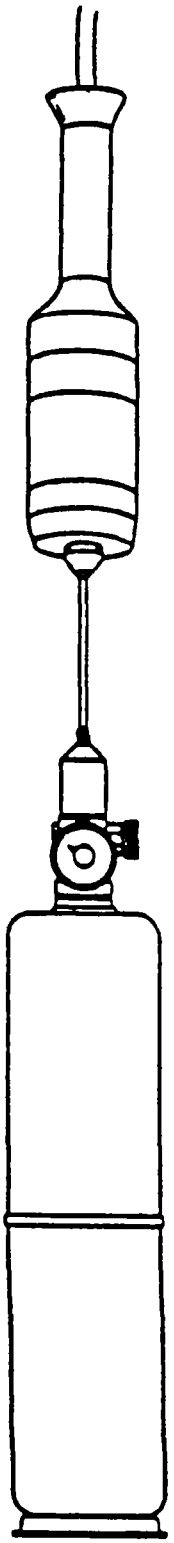
The gas flows through a critical orifice which reduces it flow rate to the proper rate for calibration purposes. The normal factory calibration of this instrument is for benzene in air. Isobutylene is used for normal calibration because it is less toxic. The relative response of isobutylene as compared to benzene is about 70 percent with the 10.2 eV and 11.7 eV lamps (there is a slight difference between the relative response of the two different energy probes, but it is not considered significant for most field calibration purposes). Accordingly, a bottle of isobutylene calibration gas that contains 100 ppm isobutylene will read out at about 70 ppm on a factory calibrated instrument. A bottle of factory calibration gas will state the proper readout on the instrument "as benzene."

If the instrument does not calibrate exactly, the span is normally adjusted to bring the instrument into calibration. If the instrument cannot be brought into calibration by using the span, the lamp may need to be cleaned or other maintenance items performed so that the unit will calibrate accurately.

OVA (ORGANIC VAPOR ANALYZER)

The instrument must first be checked for adequate hydrogen supply and battery charge. It should then be started up and stabilized for about five minutes with the flame lit. The calibration gas (usually 100 ppm methane) is then attached to the probe inlet. The span is adjusted to bring the instrument into proper calibration (using the X10 scale).

CALIBRATION TEST SETUP



CALIBRATION TEST SET UP

RCRA FACILITY INVESTIGATION DATA MANAGEMENT PLAN BASF CORPORATION WYANDOTTE, MICHIGAN

Prepared for:
BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan

September 1995

Prepared by:
Environmental Science & Engineering, Inc.
1099 West Grand River Avenue
Williamston, MI 48895
(517) 655-4391

Project Number: 4E07014
Revision: 1

DATA MANAGEMENT PLAN

1.0 OVERVIEW

The Data Management Plan outline procedures to document, track, store, and retrieve data collected from the RFI. The purpose of this plan is to effectively process the data so that it is accurate, accessible, and maintained. This plan discusses the following topics to effectively manage the data:

- Data documentation materials, procedures and files
- Data reduction
- Data presentation
- Reporting requirements

2.0 DATA DOCUMENTATION

All data collected will be properly documented by different methods. Field observations and sampling activities will be recorded using field sample sheets, soil boring logs, log books and photographs. Samples will be tracked utilizing sample identification numbers, labels, and chain-of-custody forms. The content and procedures for field documentation is detailed in the Quality Assurance Project Plan.

Technical data collected or developed in the office shall be properly referenced. These data may include the following:

- Information from books and other publications
- Input data for computer presentations
- Output or results from computer presentations

- Calculations performed
- Key telephone conversations
- Correspondence verifying information collected by telephone

These data may be documented by telephone memorandums, computer printouts, computer files on diskettes or tape. Data collected from other sources will be properly referenced.

Project documentation will be maintained and controlled through an organized project number and file number on at least the first page. Original documents will be marked as such and placed in the appropriate master file located with the RFI Consultant.

Files will consist of general files and technical files. General files will consist of the following:

- Management information
- Financial information (i.e., BASF-Consultant contract)
- Correspondence
- Other (i.e., newspaper articles)

Technical files will contain the majority of the work generated during the RFI. Much of the technical files will be obtained and maintained by the RFI Consultant retained by BASF to conduct the RFI. These files consist of all data and work products generated during the investigation including the following:

- Project plans
- Field log books
- Field sample sheets and chain-of-custody records
- Validated analytical data packages

- Calculations
- Data review notes
- Progress and technical reports
- Other pertinent information

The data will be organized in a numerical task-by-task order.

Quanterra, Inc. will maintain the raw analytical data and associated laboratory QA/QC data.

Environmental Standards, Inc. will maintain the laboratory data generated for the data validation process and the original data validation reports. The raw data and original reports will be archived in a labelled box(s). Tracking of the location of all reports is performed with a computerized database.

3.0 DATA REDUCTION

Data reduction will be conducted to condense the information into a presentable format and to meet specific data uses. Data reduction will apply to, but not be limited to, the following items:

- Internal laboratory data reduction
- Data validation and transfer
- Data reformatting, presentation, and usage
- Statistical treatment of background samples

Raw analytical data (i.e., chromatograms, calibration data) will be reduced by the laboratory into an analytical data package. The raw analytical and QC documentation will be stored at the laboratory. If necessary, this information can be retrieved at a later date. Quanterra,

Inc. currently stores the raw data indefinitely. Specific laboratory data reduction, validation and reporting procedures are specified in the Quality Assurance Project Plan (QAPP).

Environmental Standards, Inc. will review the analytical data package for completeness and validity according to procedures specified in the QAPP. Analytical results and QC data will be submitted to EPA with monthly progress reports after validation. BASF will retain a copy of all validated laboratory data packages.

The analytical results from the data package will be condensed into tables, maps or other displays to aid in the review, evaluation and presentation of the data.

Analytical results will undergo calculation for use in simulations or risk calculations. Background values will be compared to site analytical results to assess whether background concentrations have been exceeded. The statistical procedures to be used will be in accordance with RCRA guidance.

All data from the RFI and the QA/QC results will be reported according to the procedures specified in the QAPP.

4.0 DATA PRESENTATION

Data collected during the RFI will be organized and presented in a concise, logical format. Techniques for data presentation will include tabular and graphical displays.

Tabular Displays

Data presentable in tabular formats may consist of the following:

- List of analytical parameters
- Sorted and unsorted analytical data
- Sample locations survey coordinates
- Elevations
- Input and output data

Graphical Displays

Data presented in graphic formats typically illustrate trends and patterns. Several graphical displays may be used to present RFI data including the following:

- Graphs to illustrate time or distance related trends
- Cross-sections that depict vertical variation such as stratigraphy, ground water movement, borehole information or waste source configuration
- Plan maps that illustrate sample locations, areas and distribution of contaminants, and isopachs
- Three-dimensional maps which visually portray relief such as variable topographic or subsurface features, or highly variable contaminant distributions

Data and information acquired and used during the RFI will be stored in one of the following softwares:

- Word Perfect 5.1 or Word 6.0 for reports
- Lotus 2.3, 3.1 or Excel 4.0 for Tables
- Grits 4.0 for groundwater data
- AutoCad 12.0 or Integraph for Figures

Analytical data will be transferred from the laboratory to BASF, Environmental Standards, Inc., the RFI Consultant, and the EPA on diskette to eliminate errors in data re-entry.

5.0 REPORTING

The following documents are required by the conditions for the RFI:

- RFI Description of Current Conditions

- Pre-evaluation of Corrective Measure Technologies
- RFI Work Plan consisting of:
  - Project Management Plan
  - Quality Assurance Project Plan
  - Data Management Plan
  - Health and Safety Plan
  - Public Participation Plan
- Monthly Progress Reports
- RFI Report

As the work progresses, additional work plans and reports relating to interim measures and corrective measures will be prepared as required.

Schedules for the completion dates of these deliverables is provided in the Project Management Plan. The Monthly Progress Reports submitted by BASF or BASF's designee, to EPA will include the following information:

- A description and estimate of the percentage of the RFI completed
- A summary of significant findings during the reporting period
- A summary of changes made in the RFI during the reporting period
- A summary of public contacts regarding the RFI during the reporting period
- A summary of actual or potential problems encountered during the reporting period including actions taken to rectify the problems
- Changes in primary personnel carrying out the work during the reporting period
- Work projected for the next reporting period
- Copies of daily reports, laboratory and monitoring data, if requested by the agencies

RCRA FACILITY INVESTIGATION PROJECT MANAGEMENT PLAN BASF CORPORATION WYANDOTTE, MICHIGAN

Prepared for:
BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan

September 1995

Prepared by:
Environmental Science & Engineering, Inc.
1099 West Grand River Avenue
Williamston, MI 48895
(517) 655-4391

Project Number: 4E07014
Revision: 1

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

TABLE OF CONTENTS (Concluded)

LIST OF FIGURES

1.0 PROJECT DESCRIPTION, OBJECTIVES, AND APPROACH

BASF Corporation (BASF) and the U.S. Environmental Protection Agency (EPA) entered into an Administrative Order on Consent on February 28, 1994 (Docket Number V-W-001-94). Preparation of this Work Plan is the initial phase of this project. BASF conducted investigations and corrective measures at the North Works facility under a 1986 Consent Decree with the State of Michigan. That work culminated in the installation and monitoring of the groundwater extraction and treatment system currently operating at the North Works.

1.1 PROJECT DESCRIPTION

The BASF facility is located in Wayne County, at 1609 Biddle Avenue, Wyandotte, Michigan. The facility occupies approximately 230 acres. It has operated as a manufacturing facility for over 100 years. Current operations include the manufacture of polyether polyols, polyurethane plastics, compounded nylon, expanded polypropylene, and vitamins A & E, as well as chemical research. Past production activities have included the manufacture of coke, soda ash, sodium bicarbonate, calcium carbonate, calcium chloride, adhesives and phosphate coatings. A foundry also operated at the site.

This project management plan describes the administrative and technical management approach to ensure the achievement of the objectives of the RCRA facility investigation (RFI). The plan specifically addresses the following areas:

- Purpose and objectives;
- Technical Approach;
- Data Quality Objectives;
- Overall management approach to the RFI;
- Key project personnel responsibilities and qualifications; and
- Scheduling and Budgeting.

1.2 PURPOSE AND OBJECTIVES OF THE RFI

The objectives (or purpose) of this RFI as stated in the February 1994 Consent Order are:

1) to describe the nature and extent of any releases of hazardous waste or hazardous constituents from regulated units, solid waste management units (SWMUs) and other areas of concern (AOCs)
2) to evaluate the effectiveness of the current groundwater extraction system
3) to gather necessary data to support the Corrective Measures Study (CMS)

To meet the objectives of the RFI, this work plan is designed to investigate and gather the information needed to describe the presence, magnitude, extent and movement of unpermitted releases of hazardous waste or hazardous constituents at the BASF North Works. Information and data needed to meet the objectives fall into four categories:

1) information and data to identify, characterize, and define the nature, degree, and extent of contaminants and contaminant plumes,
2) information and data to perform a Health and Environmental Assessment (HEA) including the identity and characteristics of the sources of contamination, the potential migration pathways, the potential receptors, and the habitat of potential receptors,
3) information and data to support development of corrective action objectives, and
4) information to characterize sediment distribution, deposition, quality and sources in the Trenton Channel specifically adjacent to the North Works.

The history and physical setting of the North Works are described in the Current Conditions Report (CCR) and allow the data gathering tasks to be focussed on two potential migration pathways:

1) groundwater flow carrying dissolved contaminants off-site (i.e., to the Detroit River, Wayne County sewers), and
2) non-point source stormwater (surface water) runoff carrying suspended or dissolved contaminants off-site.

Ancillary to these two migration pathways are potentially contaminated subsurface and surface soils that may contribute contaminants to groundwater or stormwater.

Therefore, to meet the objectives of the consent order, the RFI report will describe the identity, extent and movement of contaminants in groundwater, soils and stormwater at the North Works so that an HEA can be performed. The HEA will quantify potential risks to human and ecological receptors; if unacceptable risks are found, a corrective measures study will follow the RFI.

If a Corrective Measures Study is necessary, implementation of corrective measures and verification of completion would be the final steps in the RCRA Corrective Action Process for the BASF North Works Facility in Wyandotte, Michigan.

1.3 TECHNICAL APPROACH

The technical approach is structured on the following specific objectives and actions.

This Work Plan describes the initial phase of work to be performed under the 1994 Consent Order. The initial phase will evaluate the existing groundwater extraction system, the distribution of contaminants in soil and groundwater near SWMUs and AOCs, sediment quality and depositional patterns in the Trenton Channel, stormwater runoff patterns and potential risks to human and ecological receptors. In summary, this phase of work will:

- Sample groundwater through new and existing wells to characterize contaminants and physical properties as well as nature and extent of contamination
- Conduct in-situ testing of the saturated zone to calculate flow rates, gradients, permeability, and other hydrogeological properties
- Assess the in-place groundwater extraction system to evaluate if that existing system prevents contaminated groundwater from leaving the facility
- Sample surface soils (0 to 12 inches) and subsurface soils in the vicinity of some SWMUs and AOCs to assess if releases occurred and to identify contaminants capable of being transported
- Focus sampling and analyses on chemicals listed at 40 CFR 264 Appendix IX and historically used at the facility and therefore, reasonably anticipated to be present

- From existing records, evaluate the history, depositional patterns and quantities of sediment in the Trenton Channel particularly adjacent to the North Works
- Evaluate physical and chemical data available on the quality of sediments in the Trenton Channel upstream, downstream and adjacent to the North Works. Based on these data, investigate the feasibility of preparing a valid sampling plan for sediments
- Examine a risk-based approach to define chemical concentrations in soils that do not pose unacceptable risks to potential receptors

Data from this initial phase of the RFI will be qualitatively and statistically evaluated in conjunction with existing validated data to assess whether a subsequent phase of the RFI is necessary. The rationale and scope of any subsequent phase will be discussed with and approved by the EPA prior to implementation.

If data from the initial phase suggests that sufficient site characterization information has been collected, the work will proceed with the HEA. A technical memorandum, presenting the data and recommendations of the HEA will be prepared and submitted to the EPA. After a review of the technical memorandum, the need for implementing a subsequent investigation will be evaluated in light of the data requirements for the CMS.

Potential work in a subsequent investigation may include:

- Additional soil and/or subsurface soil sampling
- Sampling and analyzing sediments from the Trenton Channel
- Installation of additional monitoring wells, additional in-situ testing, refining the groundwater investigation
- Treatability studies or pilot testing.

Later phases of work, if needed, will be presented to EPA as addenda to this work plan.

2.0
DATA QUALITY OBJECTIVES

The purpose of establishing and recognizing Data Quality Objectives (DQOs) is to make sure that the data collection activities focus on the information needed to make a decision or answer relevant questions leading up to a decision. The DQO process addresses identification of sample source, sampling methods, detection limits of analytical laboratory test results, the confidence limits on the estimated mean value of contaminant concentrations, and other statistical measures of data quality; more importantly, the DQO process addresses the more general objective of providing the appropriate information necessary and sufficient to make decisions.

DQOs are established to ensure that the data collected are sufficient and of adequate quality for their intended uses. EPA's Guidance (EPA 1987a, 1987b) defines DQOs as qualitative and quantitative statements that specify the quality of data required to support Agency decisions during response activities.

The sampling and analyses program contained within the QAPP describes the DQOs for each solid waste management unit (SWMU), area of concern (AOC), and media being investigated during the RFI. Each portion of the sample network design describes:

- The objectives and decision types
- The data collection program and tasks
- The intended uses and needs for the data

The ultimate objectives are to describe the nature and extent of any releases of hazardous waste or hazardous constituents and to support the corrective measures study. Therefore, the quality of the data will be adequate to identify contamination when it is present and to perform a risk assessment.

EPA Guidance supports the concept of tailoring the analytical level to the intended use of the data. The five analytical levels are briefly summarized as follows:

- Level I - field screening or analyses using portable instruments
- Level II - field analyses using more sophisticated portable analytical instruments, possibly setup in a mobile laboratory at the site
- Level III - analyses performed at an off-site analytical laboratory but without the validation or documentation procedures required of CLP Level IV analysis
- Level IV - CLP (or CLP-like) routine analytical services
- Level V - analysis by non-standard methods; CLP special analytical services are Level V but Level V analytical work is sometimes conducted by non-CLP laboratories. Tests for self-heating materials would be Level V.

In order to implement the Technical Approach the following DQOs are identified.

1. Assemble enough data to develop a Migration Pathway Evaluation. This activity will trace contaminant pathways from their current location to potential human or ecological receptors by considering release mechanisms, transport mechanisms, and exposure media. The Migration Pathway Evaluation allows sampling to focus on complete exposure pathways and on specific media of concern. Incomplete exposure pathways can be disregarded because they will not pose a threat to the environment. These data generally fall into the Level I DQO category.

2. Compile or acquire basic geology and hydrogeology information (Level I). These data will be used as input to the Migration Pathway Evaluation and to characterize background conditions around the facility.

3. Identify changes in groundwater flow patterns from the patterns established for the existing groundwater system. These data will be assembled from both new and existing in-situ hydrogeologic measurements (i.e., slug test, pump test, tracer test), groundwater elevation measurements, and other physical measurements (all Level I data). The studies will be focussed in the vicinity of sewers and the river to meet the objectives of the Consent Order.

4. Identify concentrations of contaminants in groundwater. Existing analytical data (Level III or higher) will be used to identify areas where contaminants occur in groundwater. Analytical data collected during this RFI will be Level IV and will be used to confirm the nature, extent and level of contamination. These analytical data also will be used to prepare a Health and Environmental Assessment (HEA).

5. Assess the nature and extent of releases of hazardous constituents or hazardous wastes from SWMUs or AOCs to surface soils that may migrate to the river. Analytical data (Level IV) will be used to assess risks from surface soils to aquatic life or water quality. Data should be acquired on a site-wide system in order to characterize potential impact from the site as a whole.

6. Published studies of sediment quality, depositional areas, dredging, and habitats in the Trenton Channel will be reviewed and used as Level II, III, or IV DQO information for this investigation.

Analytical DQOs such as practical quantitation limits, methods, and control limits on recoveries are described in detail within the QAPP and are not repeated here.

3.0 OVERALL MANAGEMENT APPROACH

BASF will manage the overall project. BASF has selected Environmental Science & Engineering, Inc. (ESE) as the RFI Consultant. They will provide oversight and coordination of RFI work performed at the facility and will provide consulting services for technical, regulatory, miscellaneous management, and administrative activities associated with the RFI.

Various BASF and RFI consultant technical resources will be utilized as needed for specific areas of application and to accomplish specific tasks during the RFI. The BASF and RFI Consultant Project Manager will work together to assure that project resources are effectively utilized and that deliverables, budget, and schedules are met.

BASF has selected Environmental Standards, Inc. to conduct the laboratory data validation.

An overall project organization chart is presented on Figure 1. Figure 2 presents an organization chart for the RFI project team. A description of BASF and RFI primary project personnel for responsibilities is presented below. Changes in key project personnel will be reported to the U.S. EPA in the monthly status report.

3.1 BASF AUTHORITY AND RESPONSIBILITY

The authority for BASF Project Management is illustrated for each of the responsible personnel presented in Figure 1. BASF responsibilities will include reporting to regulatory agencies, supervising and reviewing consultant's work to assure that the work performed meets technical commitments, and evaluating permit condition compliance including scheduled commitments.

3.1.1 BASF Project Coordinator

The project will be coordinated by Mr. Bruce Roberts. Mr. Roberts was awarded a Bachelor of Science in Chemical Engineering and a Masters of Environmental Systems

Engineering. He has worked for BASF or a predecessor company since 1971. For the last 16 years, Mr. Roberts has worked in environmental positions at various BASF facilities.

Mr. Roberts will be responsible for project implementation, overall management, consultant oversight, regulatory compliance and permit conformance. Mr. Roberts will be responsible for document review, management briefings, budgetary authorizations, obtaining properly-completed regulatory certification statements and authorizing communications with regulatory agencies.

3.1.2 Signature Authority

The BASF General Site Manager, Mr. Don Yarborough, has signature authority for BASF to make certification statements for regulatory purposes. Mr. Yarborough will be active in project reviews, briefings and providing community relations information.

3.1.3 BASF Support Roles

BASF will use a team of in-house staff members to support the RFI. The identity and roles of these individuals are listed below and illustrated on Figure 2:

Public Relations	-	Don Yarborough
Quality Assurance and Chemistry	-	Kathy Hillig
Health and Safety	-	Doug Thiel
Hydrogeology	-	John Byrnes
Engineering	-	Barry Barkel
Wastewater Discharge Permits	-	Charles Anderson
Review of Deliverables	-	Bruce Roberts
Legal	-	Doug Martin
Review of Deliverables	-	Dale Webster
Remedial Systems	-	Pete Greer

Team members will be dedicated to the RFI on an as needed basis at the discretion of the Project Coordinator.

3.2 RFI CONSULTANT AUTHORITY AND RESPONSIBILITIES

The authority and responsibilities of the RFI Consultant personnel presented on the project organization chart in Figure 2 are as follows:

3.2.1 Project Manager

The RFI Consultant Project Manager, Mr. Douglas Marian, will be the prime contact with BASF. Project organization and management procedures of the RFI Work Plan will be administered by the Project Manager, including daily management responsibilities, reviews and approval of work scope, budget, schedules, and reports. The Project Manager will review and coordinate financial reporting and subcontractor recommendations for BASF's approval.

3.2.2 Management Oversight Reviewer

The RFI Consultant's Project Manager, Mr. Mark Haney, will work under the direction of a management oversight reviewer, who will be available to BASF as needed to resolve any contractual, budgetary, or administrative matters, and to provide additional technical expertise.

3.2.3 Peer Reviewer

The Peer Reviewer, Mr. Robert Hilty, will interact with the RFI Project Manager to obtain all data and schedules relevant to the Peer Review. He will review documents to confirm that performance conforms to the requirements of the Work Plan. He will review assumptions, technical approaches, solutions, adequacy of the data collection process, quality of data used in any analyses, and confirm that federal, state, and municipal regulations, as applicable, have been satisfied.

3.2.4 Quality Assurance Manager

The Project Quality Assurance Manager, Ms. Kim Johnson, will be responsible for verifying that sampling and analytical operations are carried out according to the Quality Assurance Project Plan. The Project Quality Assurance Manager or designee shall be responsible for performance and system audits of field data reduction/verification activities, and for specifying corrective action as required. The Project Quality Assurance Manager will review field QC test results and laboratory operations. In addition, the Project Quality Assurance Manager will prepare QA reports.

3.2.5 Health and Safety Officer

The RFI Consultant's Health and Safety Officer (HSO), Mr. Arnold Kaeppeler, will coordinate Health and Safety issues with the BASF Safety Coordinator, Mr. Douglas Thiel. The Health and Safety Officer will be responsible for implementing the RFI site-specific health and safety directives contained in the RFI Health and Safety Plan. The HSO will interface with the Project Manager and will monitor compliance with the Health and Safety Plan. The HSO will, as necessary, suspend work activities or direct personnel to change work practices deemed hazardous to safety or health.

3.2.6 Task Leaders

The Task Leaders, such as field manager, hydrogeologist and risk assessors will direct the efforts required to accomplish the associated task. Responsibilities include personnel and equipment allocations, plan implementation, daily coordination of activities, and scheduling. The Task Leaders will report to the Project Manager. The Task Leader will monitor quality assurance and review all documentation for compliance to project requirements.

3.2.7 Data Validation

The Data Validation QA Manager, Dr. Rock Vitale, or designee shall be responsible for performance and system audits of laboratory and data reduction/verification activities and specifying corrective action as required. The QA Manager will receive all raw laboratory data, review laboratory operations, prepare QA reports, and submit validated laboratory data to BASF.

3.3 ANALYTICAL LABORATORY

Quanterra Environmental Services, Inc., of North Canton, Ohio, is a qualified analytical laboratory, experienced in Contract Laboratory Procedures (CLP) and practices. This laboratory was selected by BASF to provide expertise in preparation of the QAPP and in the chemical analyses of environmental samples obtained during the RFI. The laboratory will present results to the BASF Project Coordinator and to the RFI Consultant Project Manager. The laboratory will conform with all requirements of the RFI Quality Assurance Project Plan.

Quanterra Project Manager - Mr. Tom Himes

The Quanterra Project Manager will report directly to the BASF Project Coordinator. The project manager is responsible for coordinating Quanterra's duties with the RFI Consultant's Project Manager. He will be responsible for the following:

- Ensuring all resources of the laboratory are available on an as-required basis; and
- Overviewing of final analytical reports.

Quanterra Operations Manager - Mr. Christopher Oprandi

The Quanterra Operation Manager will report to the Quanterra Project Manager and will be responsible for:

- Coordinating laboratory analyses
- Supervising in-house chain-of-custody
- Scheduling sample analyses
- Overseeing data review
- Overseeing preparation of analytical reports
- Approving final analytical reports prior to submission to Environmental Standards, Inc. for data validation.

Quanterra Quality Assurance Officer - Ms. Opal Davis-Johnson

The Quanterra QA Officer has the overall responsibility for data after it leaves the laboratory. The Quanterra QA Officer will be independent of the laboratory but will communicate data issues through the Quanterra Project Manager. In addition, the Quanterra QA Officer will:

- Overview laboratory quality assurance
- Overview QA/QC documentation
- Conduct detailed data review
- Determine whether to implement laboratory corrective actions
- Define appropriate laboratory QA Procedures
- Prepare laboratory Standard Operation Procedures
- Sign the title page of the QAPP

Quanterra Sample Custodian - Ms. Lois Ezzo

The Quanterra Sample Custodian will report to the Quanterra Operations Manager. Responsibilities of the Quanterra Sample Custodian will include:

- Receiving and inspecting the incoming sample containers
- Recording the condition of the incoming sample containers
- Signing appropriate documents
- Verifying chain-of-custody and its correctness
- Notifying laboratory manager and laboratory supervisor of sample receipt and inspection
- Assigning a unique identification number and customer number, and entering each into the sample receiving log
- With the help of the laboratory manager, initiating transfer of the samples to appropriate lab sections
- Controlling and monitoring access/storage of samples and extracts

Quanterra Technical Staff

Quanterra's technical staff will be responsible for sample analysis and identification of corrective actions. The staff will report directly to the Quanterra Operations Manager.

Final responsibility for project quality rests with the Quanterra Project Manger. Independent quality assurance will be provided by the Quanterra Project Manager and QA Officer prior to release of all data to BASF and to Environmental Standards, Inc.

3.4 CONTRACTORS

The following are contractors who will be added to the RFI activity to provide specific services, as appropriate:

3.4.1 Drillers

BASF will contract qualified licensed drillers who will drill boring to obtain subsurface soil samples, install monitoring wells, and perform other related drilling services. The RFI Consultant Project Manager and/or Field Manager will oversee the driller's work.

3.4.2 Land Surveyors

BASF will contract with land surveyors who will be responsible for locating borings, monitoring wells, and other physical features as necessary to document accurate field locations during the RFI. Locations will be tied into the Coordinate System currently in use at the facility. The surveyor will be a Registered Land Surveyor and will coordinate activities with the BASF Project Coordinator and RFI Consultant Project Manager.

3.5 ENVIRONMENTAL PROTECTION AGENCY

3.5.1 U.S. EPA RCRA Project Manager

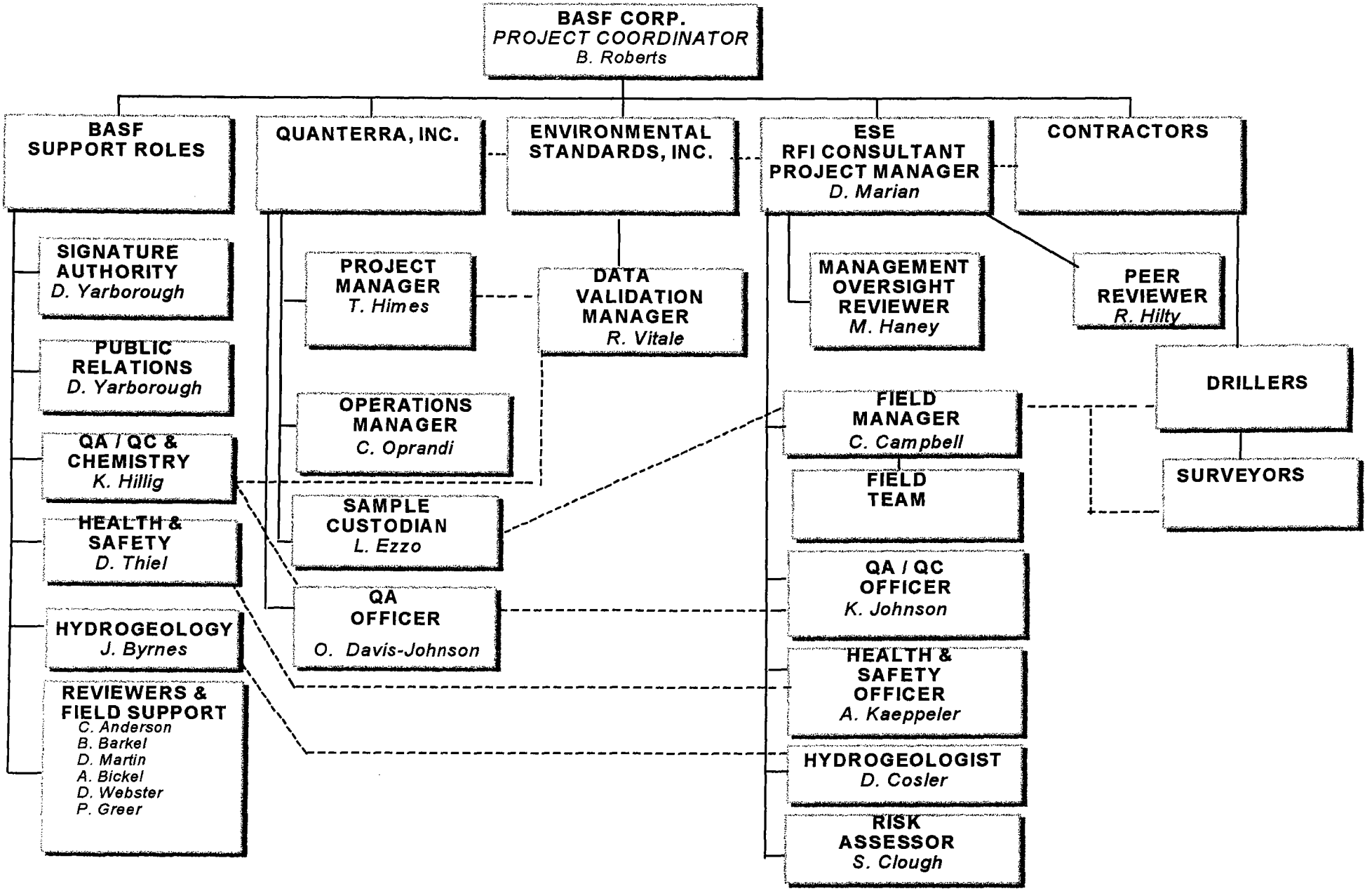
Ms. Diane Sharrow has overall responsibility for all phases of the RFI/CMS. She will provide review and approval of work plans, QAPP, reports, schedules, and specifications.

3.5.2 U.S. EPA Region V Quality Assurance Manager - Mr. Willie Harris

EPA RQAM has the responsibility to review and approve all Quality Assurance Project Plans (QAPPs). Additional EPA responsibilities for the project include:

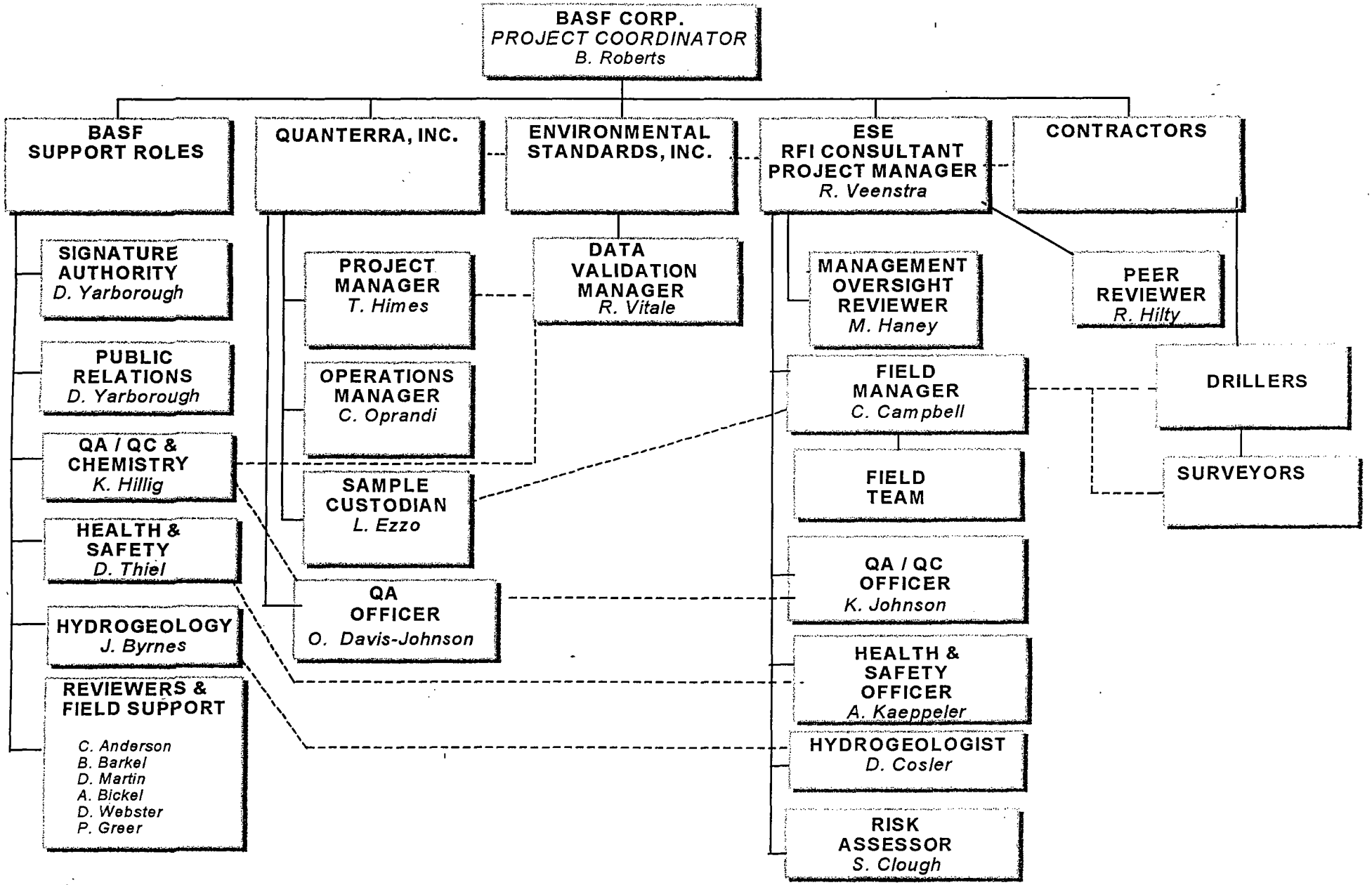
- Conducting external Performance and System audits of RFI Laboratory
- Reviewing and evaluating analytical laboratory and field procedures

FIGURE 2
RFI MATRIX ORGANIZATION



REVISION 2 8/29/96

FIGURE 2
RFI MATRIX ORGANIZATION



REVISION 1 9/20/95

Report: Classic Gantt
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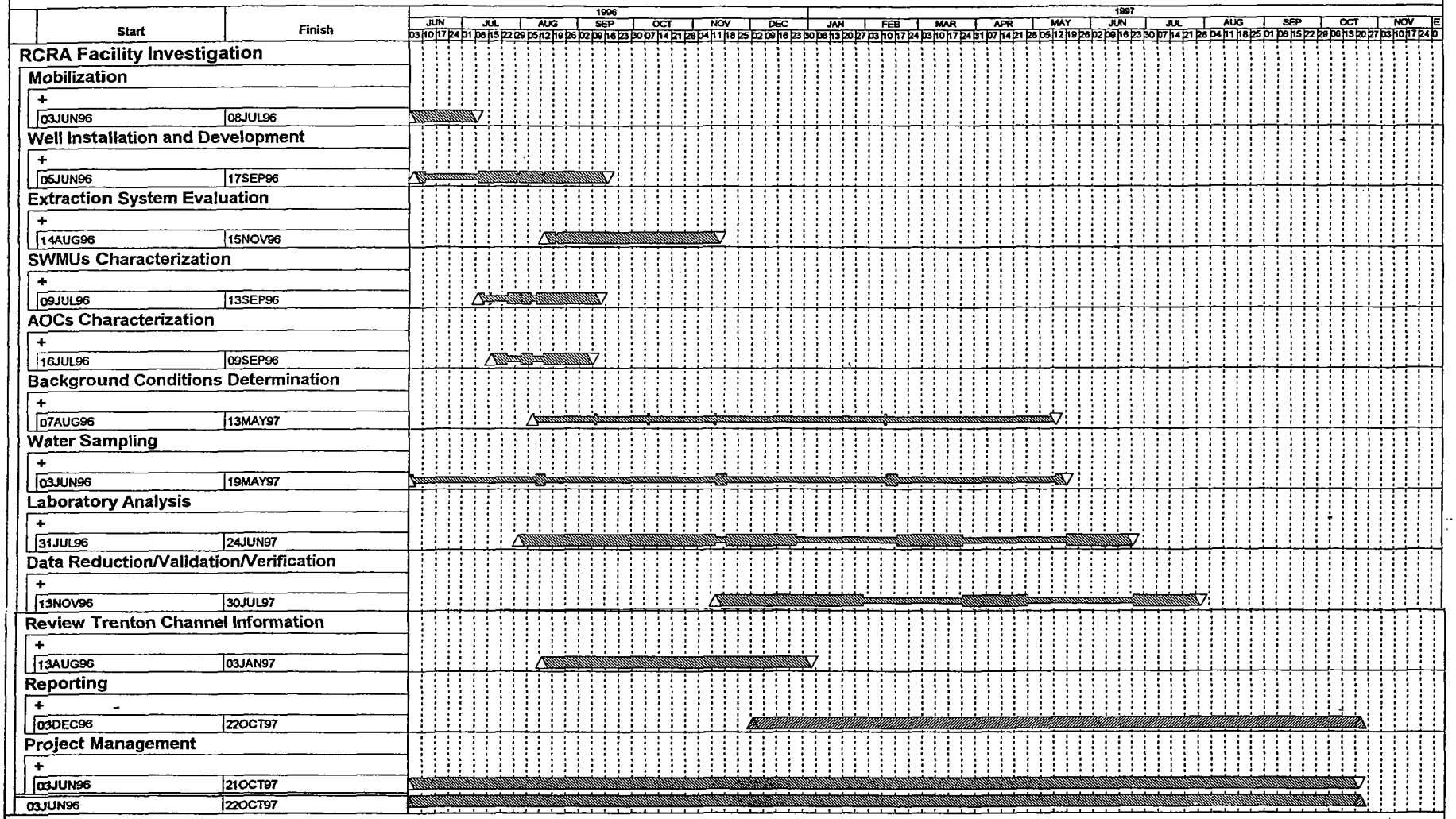
Filter: All Activities

BASF North Works
RCRA Facility Investigation

Wyandotte, Michigan
Report Date: 03SEP96



Environmental Science & Engineering, Inc.

		Date	Revision	Checked	Approved
Data date	03JUN96	20MAY96	1.0 (Draft)	DMB	RBV
Start date	03JUN96	21MAY96	2.0 (Draft)	DMB	RBV
Finish date	22OCT97	21MAY96	3.0 (Final)	RBV	BDR
		30AUG96	4.0 (Draft)	DMB	DM

FIGURE 3

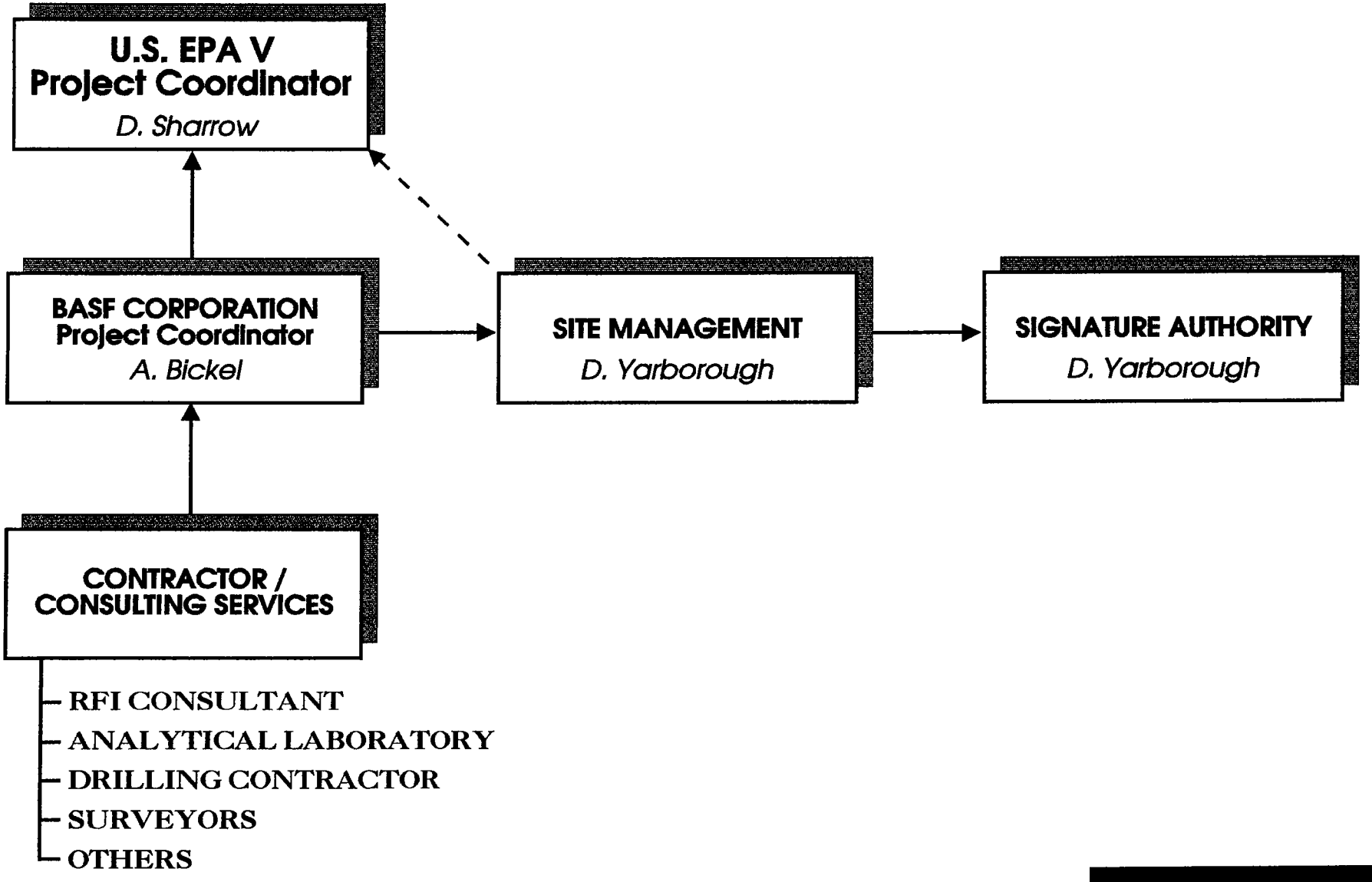
4.0
SCHEDULE

A proposed schedule for the initial phase of the RFI is shown in Figure 3. Any necessary modifications in scheduling will be documented in the Monthly Progress Reports to EPA as the findings from the initial tasks are evaluated. Schedules for any necessary subsequent phases of investigation will be presented in subsequent Work Plans.

5.0
BUDGET

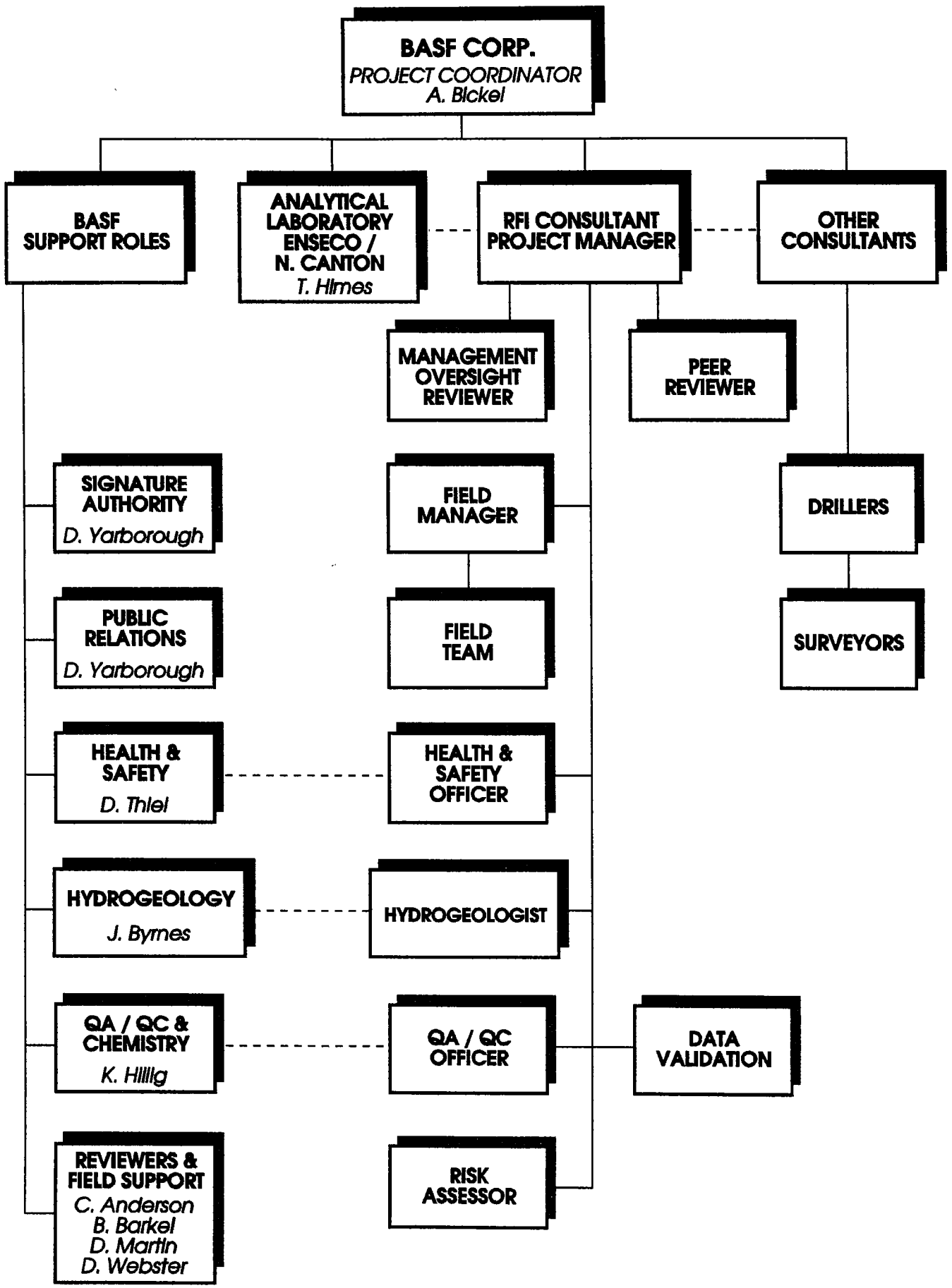
The anticipated budget for the work described in the Work Plan is presented under separate cover. BASF requests that the budget information remain as Confidential Business Information. Budget estimates for additional phases, tasks, etc., as necessary, will be provided with the Work Plan Addenda as the findings from the initial tasks are evaluated.

FIGURE 1
OVERALL PROJECT ORGANIZATION



Woodward-Clyde

FIGURE 2
RFI MATRIX ORGANIZATION

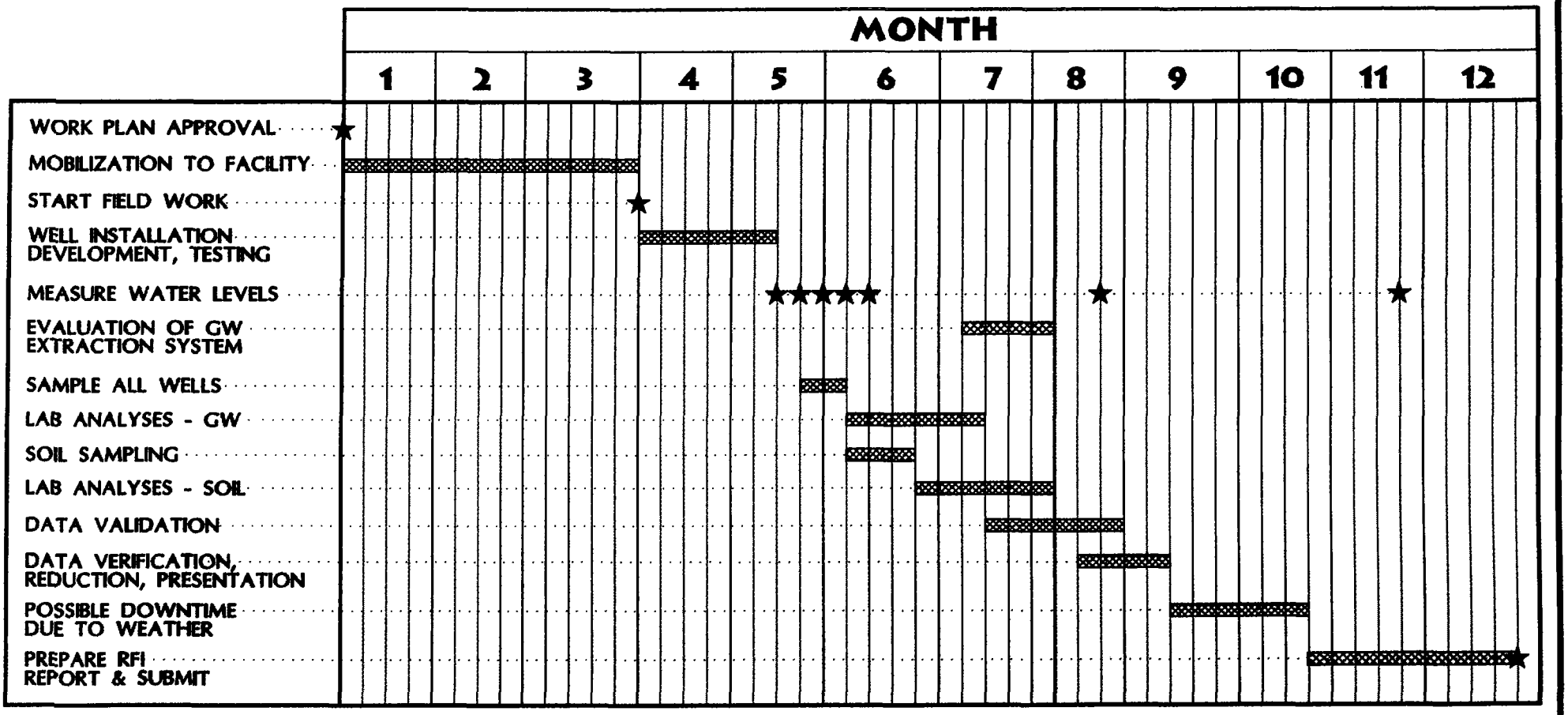


MAY 1994, DAS - 7014-RFI.CDR

Woodward-Clyde

PRELIMINARY:

FINAL SCHEDULE TO BE FILED WITH QAPP



★ EVENT

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Woodward-Clyde Consultants
ENGINEERS, GEOLOGISTS, AND ENVIRONMENTAL SCIENTISTS

BASF CORPORATION
WYANDOTTE, MICHIGAN
SCHEDULE FOR RFI ACTIVITIES

DESIGN: JL	CHK'D: SA	PROJECT NO. 4E07014	FIG. NO. 3
DRAWN: DAS	DATE: 5/25/94		

RCRA FACILITY INVESTIGATION PUBLIC PARTICIPATION PLAN BASF CORPORATION WYANDOTTE, MICHIGAN

Prepared for:
BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan

March 1995

Prepared by:

Woodward-Clyde

38777 W. Six Mile Road
Suite 200
Livonia, Michigan 48152
Telephone: 313/464-1800

Project Number: 4E07014
Revision: 0

PUBLIC PARTICIPATION PLAN

This Public Participation Plan describes the mechanism for continued participation in technical and advisory work groups and for disseminating information to the public regarding the RCRA Facility Investigation (RFI) activities and results for the BASF Facility in Wyandotte, Michigan.

Participation in Technical and Advisory Work Groups

BASF Corporation, as a major Detroit River stakeholder, has been actively involved in the Detroit River Remedial Action Plan (RAP) process through participation on the Binational Public Advisory Council (BPAC) which advises the RAP team. BASF has provided information and assistance to both groups virtually since the beginning of the RAP process in the Detroit River Area of Concern.

BASF representatives have been active members on two of the four RAP Technical Work Groups (TWGS): the Contaminated Sediments TWG and the Point Source/Nonpoint Source TWG. (The other two TWGs are the Combined Sewer Overflow TWG and the Habitat TWG). BASF provided information specific to BASF facilities and properties for the Stage 1 RAP Document that described various aspects of the area of concern and identified the impaired beneficial uses of the Detroit River. More recently, BASF representatives assisted in writing the current (final) draft of the Stage 2 RAP Document, which recommends corrective actions to address impaired beneficial uses. On several occasions, BASF hosted TWG meetings and provided tours of its North Works and Fighting Island for RAP team and BPAC members.

BASF representatives have attended BPAC meetings from the start. In August 1992, a BASF representative was appointed to the BPAC as one of the designated U.S. industrial members. (The number and constituency of the fifty members of the BPAC are set forth in the Bylaws). In May 1994, a BASF representative was elected Second Vice Chairperson of

the BPAC. Therefore, BASF's continuing participation in the BPAC and the RAP process is assured.

Disseminating Information to the Public

BASF Corporation has designated spokespersons to respond to questions concerning the RFI that might arise from the public. The currently designated primary and alternate spokespersons listed in order in which inquiries should be directed, are:

- Don Yarborough, Public Relations, and primary spokesperson (313)246-6161;
- Bruce Roberts, Corporate Ecology and Safety (313) 246-5211; and
- Doug Thiel, Manager Quality and Ecology Services (313) 246-6209.

Alternatively, letters may be sent to:

BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan 48192

Attn: Don Yarborough

BASF will respond by appropriate method. If a town meeting is required by EPA relating to the RFI, a notification will be prepared by BASF and printed in the local newspapers and will be mailed to individuals who have requested notification of meetings concerning environmental matters.

BASF sponsors a Community Advisory Panel to review and discuss the facility's operations, environmental performance, safety, emergency preparedness and social commitments to the community. Approximately 10 to 15 representatives from the city, civil and business groups, local residents, community leaders, environmental interests and BASF, make up the Panel. A representative from BASF serves as Chairperson.

Panel members serve as an advisory group and not a decision-making body. The Advisory Panel members have no formal association within the BASF Wyandotte facility; the Advisory Panel is asked to share community perspectives and provide input on selected topics.

Meetings currently are held on the second Thursday of each month, either at the Wyandotte facility (if a site tour is planned) or at a local restaurant meeting room. BASF publishes the minutes from the meetings.

BASF may publish and distribute to the public fact sheets addressing issues associated with the RFI. A copy of each fact sheet discussing the RFI and the minutes of the Community Advisory Panel meetings relating to the RFI will be placed on file at the Beacon Memorial Public Library on Biddle Avenue in Wyandotte. BASF also plans to place a copy of final RFI Reports on file at the public library.

BASF is committed to providing information to the community that is useful in assessing and responding to the community's concerns. BASF will maintain these channels for disseminating information during the RFI.

RCRA FACILITY INVESTIGATION PUBLIC PARTICIPATION PLAN BASF CORPORATION WYANDOTTE, MICHIGAN

Prepared for:
BASF Corporation
1609 Biddle Avenue
Wyandotte, Michigan

March 1995

Prepared by:

Woodward-Clyde

38777 W. Six Mile Road
Suite 200
Livonia, Michigan 48152
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Project Number: 4E07014
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BASF will respond by appropriate method. If a town meeting is required by EPA relating to the RFI, a notification will be prepared by BASF and printed in the local newspapers and will be mailed to individuals who have requested notification of meetings concerning environmental matters.

BASF sponsors a Community Advisory Panel to review and discuss the facility's operations, environmental performance, safety, emergency preparedness and social commitments to the community. Approximately 10 to 15 representatives from the city, civil and business groups, local residents, community leaders, environmental interests and BASF, make up the Panel. A representative from BASF serves as Chairperson.

Panel members serve as an advisory group and not a decision-making body. The Advisory Panel members have no formal association within the BASF Wyandotte facility; the Advisory Panel is asked to share community perspectives and provide input on selected topics.

BASF Corporation - RFI
USEPA Docket No.: V-W-011-94
Public Participation Plan

Meetings currently are held on the second Thursday of each month, either at the Wyandotte facility (if a site tour is planned) or at a local restaurant meeting room. BASF publishes the minutes from the meetings.

BASF may publish and distribute to the public fact sheets addressing issues associated with the RFI. A copy of each fact sheet discussing the RFI and the minutes of the Community Advisory Panel meetings relating to the RFI will be placed on file at the Beacon Memorial Public Library on Biddle Avenue in Wyandotte. BASF also plans to place a copy of final RFI Reports on file at the public library.

BASF is committed to providing information to the community that is useful in assessing and responding to the community's concerns. BASF will maintain these channels for disseminating information during the RFI.

1.0
PROJECT DESCRIPTION

1.1 INTRODUCTION

BASF Corporation and Woodward-Clyde Consultants submit this Quality Assurance Project Plan (QAPP) to the Environmental Protection Agency (EPA), Region V, for the RCRA Facility Investigation (RFI) at the BASF Facility (North Works) in Wyandotte, Michigan. This QAPP is one part of the RFI Work Plan and is submitted in accordance with an Administrative Order on Consent (Docket No. V-W-011-94). The other parts of the RFI Work Plan describe project management, data management, health and safety, and public participation.

This QAPP describes protocols to be followed by personnel during field and laboratory sampling and analytical work. The objective of the QAPP is to provide procedures that ensure and document the precision, accuracy, completeness, and representativeness of data generated during field activities and laboratory analyses.

This QAPP presents the organization, data quality objectives, functional activities and specific quality assurance (QA) and quality control (QC) activities associated with the RFI for the BASF Facility in Wyandotte. This QAPP also describes the specific protocols which will be followed for sampling, sample handling, storage, chain of custody, and laboratory analyses.

The tasks described in this QAPP encompass all activities proposed for the initial phase of the work. Subsequent phases may be performed. The need for subsequent phases will be assessed as this work progresses, as data are interpreted, and as the need arises. Decision points are described in the text.

The North Works has been an industrial complex since the 1890s. Waste management procedures followed the procedures of the day. The elevation of the site was raised by placement of materials that were waste products generated from the former soda ash complexes. In light of these facts, BASF proposes a site-wide approach to investigating and characterizing the facility. Contamination is known to be present on site in groundwater and subsurface materials. BASF intends to investigate the nature and extent of contamination, but will focus the efforts on the facility boundaries. This approach is consistent with the presumptive remedy of on-site containment of groundwater.

1.1.1 Overall Project Objectives

The objectives (or purpose) of this RFI as stated in the February 1994 Consent Order are:

1) to describe the nature and extent of any releases of hazardous waste or hazardous constituents from regulated units, solid waste management units (SWMUs) and other areas of concern (AOCs),
2) to evaluate the effectiveness of the current groundwater extraction system, and
3) to gather necessary data to support the Corrective Measures Study (CMS).

To meet the objectives of the RFI, this work plan is designed to investigate and acquire the information to describe the presence, magnitude, extent and movement of unpermitted releases of hazardous waste or hazardous constituents at the BASF North Works. Information and data needed to meet the objectives fall into four categories:

1) information and data to identify, characterize, and define the nature, degree, and extent of contaminants and contaminant plumes,
2) information and data to perform a Health and Environmental Assessment (HEA) including the identity and characteristics of the sources of contamination, the potential migration pathways, the potential receptors, and the habitat of potential receptors,
3) information and data to support development of corrective action objectives, and

4) information to characterize sediment distribution, deposition, quality and sources in the Trenton Channel specifically adjacent to the North Works.

The history and physical setting of the North Works, described in the Current Conditions Report (CCR) and summarized in Sections 1.2 and 1.3 of this QAPP, allow the data gathering tasks to be focussed on two potential migration pathways:

1) groundwater flow carrying dissolved contaminants off-site (i.e., to the Detroit River, Wayne County sewers), and
2) non-point source stormwater (surface water) runoff carrying suspended or dissolved contaminants off-site.

Ancillary to these two migration pathways are potentially contaminated subsurface and surface soils that may contribute contaminants to groundwater or stormwater.

Therefore, to meet the objectives of the consent order, the RFI report will describe the identity, extent and movement of contaminants in groundwater, soils and stormwater at the North Works so that an HEA can be performed. The HEA will quantify potential risks to human and ecological receptors; if unacceptable risks are found, a corrective measures study will follow the RFI.

If a Corrective Measures Study is necessary, implementation of corrective measures and verification of completion would be the final steps in the RCRA Corrective Action Process for the BASF North Works Facility.

1.1.2 Project Status/Phase

BASF and EPA entered into an Administrative Order on Consent on February 28, 1994. Preparation of this Work Plan is the initial phase of this project. BASF had conducted investigations and corrective measures at the North Works facility under a 1986 Consent

Decree with the State of Michigan. That work culminated in the installation and monitoring of the groundwater extraction and treatment system currently operating at the North Works.

This QAPP describes the initial phase of work to be performed under the 1994 Consent Order. The initial phase will evaluate the existing groundwater extraction system, the distribution of contaminants in soil and groundwater near SWMUs and AOCs, sediment quality in the Trenton Channel, sediment deposition patterns in the Trenton Channel, stormwater runoff patterns, and potential risks to human and ecological receptors. In summary, this phase of work will:

- Sample groundwater through new and existing wells to characterize chemical and physical properties as well as nature and extent of contamination
- Conduct in-situ testing of the saturated zone to calculate flow rates, gradients, permeability, and other hydrogeological properties
- Assess the in-place groundwater extraction system to evaluate if that existing system prevents contaminated groundwater from leaving the facility
- Sample surface soils (0 to 12 inches) and subsurface soils in the vicinity of SWMUs and AOCs to assess if releases occurred and to identify contaminants capable of being transported
- Focus sampling and analyses on chemicals historically used or found at the facility and, therefore, reasonably anticipated to be present
- Evaluate physical and chemical data available on the quality of sediments in the Trenton Channel adjacent to the North Works
- Examine a risk-based approach to define contaminant concentrations in surface soils that do not pose unacceptable risks to potential receptors

In general, analyses of chemicals in soil and groundwater will be for parameters listed at 40 CFR 264, Appendix IX; however modifications to the list are presented where BASF has adequate knowledge of chemicals or wastes managed at a specific location. These are discussed further in Section 1.4.2 and listed on Table 7.4. The chemicals excluded are

chlorinated dioxins, furans and organophosphate pesticides. Reference to Appendix IX hereinafter excludes these chemicals.

Data from this initial phase of the RFI will be qualitatively and statistically evaluated in conjunction with existing validated data to assess whether a subsequent phase of the RFI is necessary. The rationale and scope of any subsequent phase will be discussed with and approved by the EPA prior to implementation.

If data from the initial phase suggests that sufficient site characterization information has been collected, the work will proceed with the HEA. A technical memorandum, presenting the data and recommendations of the HEA will be prepared and submitted to the EPA. After a review of the technical memorandum, the need for implementing a subsequent investigation will be evaluated in light of the data requirements for the CMS.

Potential work in a subsequent investigation may include:

- Additional soil and/or subsurface soil sampling
- Sampling and analyzing sediments in the Trenton Channel adjacent to the North Works
- Installation of additional monitoring wells, additional in-situ testing, refining the groundwater investigation
- Treatability studies or pilot testing.

Later phases of work, if needed, will be presented to EPA as addenda to this work plan.

1.1.3 QAPP Preparation Guidelines

This QAPP has been prepared in accordance with the "Region 5 Model RCRA Quality Assurance Project Plan", dated, May 1993 and attached to the Consent Order.

Other documents which have been prepared for the BASF RFI and referenced in this QAPP include:

- Current Conditions Report (CCR)
- Project Management Plan (PMP)
- Data Management Plan (DMP)
- Health and Safety Plan (HSP)
- Public Participation Plan (PPP)

1.2 SITE/FACILITY DESCRIPTION

1.2.1 Location

The BASF Corporation North Works facility is located on the U.S. shore of the Detroit River in Wayne County at 1609 Biddle Avenue, Wyandotte, Michigan (Sections 21 and 28, T. 3 S., R. 11 E). It is one mile north of the downtown area of Wyandotte.

1.2.2 Facility/Site Size and Borders

The facility occupies approximately 230 acres. The facility is bounded on the north by Perry Street and a marina across Perry Place, on the south by Mulberry Street and Wyandotte General Hospital, on the east by the U.S. Harbor Line of the Detroit River (Trenton Channel) and on the west by Biddle Avenue and City of Wyandotte properties. Commercial establishments are across Biddle Avenue. Figure 1-1 is a General location map, and Figure 1-2 illustrates the site features.

1.2.3 Natural and Manmade Features

Prior to European habitation, the site was part of a Detroit River marsh. Development of the facility began around 1890, presumably after surface water drainage and site infrastructure development. Approximately 25 to 30 percent of the surface area currently is covered with

buildings, paved streets, paved parking lots, tank farms, surface impoundments and docks. Several different manufacturing plants operate at this facility and several former plants, production, and storage units have been removed. Also, brine wells, a coke plant, an electric power generating plant and other related structures have been discontinued, abandoned and/or removed.

Many of the historical above ground structures have been demolished, but the concrete at or below grade remains. An extensive network of utilities including potable water and service water lines, storm sewers, sanitary sewers, electrical and telephone are underground. Other utilities typical of an industrial facility this size and age remain abandoned underground even though large sections are no longer used and are isolated from the active lines (SSP&A, 1984).

The eastern half to two-thirds of the site is reclaimed marshland and riverbottom and the site's land surface consists of fill materials (Figure 1-2A in CCR).

The site has a long dock that separates the fill from the river. The dock extends approximately 4700 feet from the northeast corner of the site to a point about 850 feet from the southeast corner of the site. The dock is capped by concrete over a wood deck that rests on steel pilings driven into clay beneath about 20 to 25 feet of water. The landward side of the dock was walled with a double layer of 3-inch-thick vertical, overlapping oak timbers. The area between the dock and higher ground was filled to bring the site to approximate present grade. The fill material occupies the full length of the site in a wedge that ranges in thickness from 0 to 22 feet and extends from near Biddle Avenue to the river, about 1000 feet wide on the north boundary to about 2400-feet wide across the center of the site (SSP&A, 1984).

1.2.4 Topography

Elevations on the facility are in relation to the International Great Lakes Datum (IGLD). Topographic relief of the present surface is relatively low. The southern half of the site lies

between 575 and 580 feet; the northern half of the site is generally between 580 and 585 feet, except in areas where DBO (distiller blow off) from soda ash manufacture and lime waste were deposited, where elevations are from 582 to 591 feet. The elevation of the Detroit River is approximately 572 ft (IGLD).

1.2.5 Local Geology and Hydrogeology

Geology

The geology of the site consists of industrial fill overlying organic peaty material on fluvial sand, lake clay and dolomitic bedrock (Dundee limestone or Detroit River Group). Materials at the surface consist of heterogeneous fill, that covers the entire length of the facility. The fill material consists of cinders, crushed limestone, sand, gravel, cobbles, clay, bank sand, timbers, bricks, broken concrete, and residuals from the production of soda ash and coke. The fill layer ranges in thickness from 0 to 22 feet and extends from the Detroit River to near Biddle Avenue. The fill typically is 2-feet thick along the western boundary, and increases in thickness easternward. Figure 1-3 provides a typical cross-sectional view of the subsurface.

The deposits under the fill vary by location. Typically, a sand layer underlies the fill on the western side of the facility; an organic-rich peat or clay layer underlies the fill through the central portion, and a thick lacustraine clay underlies the fill on the eastern side. The thickness of the sand and peat layers together can reach 20 ft.

The lacustrine clay unit extends under the sand and peat layers to underlie the entire site. Boring logs show that it ranges from 40 to 70 ft thick. The clay is typical of low-permeability lake-bottom deposition that occurred during the last inter-glacial period when water levels in the Great Lakes stood much higher than today.

Dolomites assigned to either the Dundee Formation or the Detroit River Group (Devonian) are approximately 150 ft thick and underly the lacustrine clay. The dolomites occur approximately 70 ft below the surface.

Hydrogeology

Groundwater at the facility occurs both in the surficial deposits and in limestone bedrock. The groundwater within the limestone is high in sulfur rendering it unfit for consumption. The lake clay has low permeability and effectively isolates groundwater in the fill and sand from groundwater below. Groundwater is not used at the facility and no potable water wells are in Wyandotte. Water in the vicinity of the facility is provided by the City of Wyandotte. The source of the water supply for the City of Wyandotte is the Detroit River.

Hydrogeologic investigations were conducted at the facility by S.S. Papadopulus & Associates, Inc., (SSP&A) in 1984, 1985 and 1988. These investigations were completed both before the current groundwater extraction system was installed or soon afterwards. Some site features described by SSP&A, such as the open ditches, have since been filled and no longer influence groundwater movement.

The investigations demonstrated that most groundwater at the facility discharged into the Detroit River and the local sewer system (SSP&A, 1984). Discharge to the Detroit River and sewers occurred predominantly by direct diffuse flow. Total flow of groundwater from the facility and to the Detroit River was estimated at 2,200 ft^3/day (11 gpm).

The pattern of groundwater flow with respect to the Detroit River varied by season (SSP&A 1984). On the eastern portion of the facility, water migrated toward the river during two-thirds or more of the year and away from the river during one-third of the year (June to September). In the western portion of the facility (away from the Detroit River), hydraulic gradients did not change significantly during the course of the year.

The hydrogeologic investigations demonstrated that fill underlying the facility are non-homogenous and have large areas of low transmissivity. Transmissivities of fill underlying the site range from 0.32 ft^2/day to 2,600 ft^2/day. Transmissivities were highest in the areas mid-way between Biddle Avenue and the river. The area of lower transmissivity was in the eastern quarter (river side) of the facility.

Hydrogeologic investigations conducted at the facility (SSP&A, 1984) were used to design the groundwater extraction well system that would minimize migration of contaminated groundwater to the Detroit River.

The Detroit River

The Detroit River is the major hydrologic feature near the facility. Approximately 98% of the river's flow enters from Lake St. Clair (U.S. EPA, et. al., 1988). The river discharges an average of 84 million gallons of water per minute (gpm) and ranges from 51 million to 110 million gpm depending on the season. Flow velocities average 1 to 2 miles/hr but can reach 6 mi/hr in the Trenton Channel. Water depth and velocity in the river are directly affected by seasonal and annual variations in Lakes St. Clair and Erie. The river's gradient is relatively uniform from Lake St. Clair to Lake Erie, falling 3 ft over a distance of 31 miles. The average time for water to pass from Lake St. Clair to Lake Erie (the entire length of the Detroit River) is approximately 21 hours.

The North Works facility borders the Trenton Channel of the Detroit River. The Army Corp of Engineers (COE) dredged the channel to maintain water depths off the BASF dock at 26 ft.

The COE reports that the last time the Trenton Channel was dredged was prior to 1970. The COE performs "strike surveys" every two to three years to identify high spots or obstructions. If the survey finds obstructions they are knocked down or removed.

1.3 Site/Facility History

The history at the facility is summarized below. A detailed chronology is presented in Section 2.0 of the Current Conditions Report.

1.3.1 General History

Ownership and name changes occurred several times throughout the history of the North Works Facility. Originally founded in 1893, the Michigan Alkali Co. produced soda ash, baking soda and lye. In 1943 it merged with the JB Ford Company to form the Wyandotte Chemicals Corporation. Wyandotte Chemicals was then purchased in 1969 by BASF AG, and in 1970 the company was re-named BASF Wyandotte Corporation. Finally, in 1986 the company became BASF Corporation; its current name.

Development at the North Works Facility has three basic milestones:

1) Construction of the original soda ash complex (1890s)
2) Construction of a larger, relocated Soda Ash Complex (1920s)
3) Demolition of the Soda Ash Complex and reconfiguration to specialty plants (1970s)

In 1893 the Michigan Alkali Company was established. Building construction began in 1895, and operation of the Soda Ash Complex began in 1896. The complex was located at the front (western) third of the current North Works facility while the eastern two-thirds remained marsh. This soda ash complex consisted of a bicarbonate production plant, lime kilns, coke plant, FM (finishing machines), and a soda ash storage and shipping area. This complex remained in operation until the 1920s when a larger Soda Ash Complex was built at the North Works. It was built on the eastern third of the site for the most part on industrial fill generated by the older soda ash complex. The old soda ash complex was subsequently dismantled. The newer complex operated from the 1920s to 1978. It also was made up of several production units each of which was either a separate plant or part of an existing

plant. In general, many plants have operated throughout the history of North Works; however, most have since closed and been demolished. These plants include:

- Original Soda Ash Complex (1890s-1920s)
- 1920s Soda Ash Complex (1920s-1978)
  - Ash Shipping and Storage (1920s-1970s)
  - Crude Bicarbonate of Soda Production (1920s-1970s)
  - FM Finishing Machines for calcining and drying (1920s-1970s)
  - Lime Kilns (1920s-1978)
  - Refined Bicarbonate (1926-1970s)
  - Coke Plant (1927-1966)
  - Purecal (Calcium Carbonate Production)(1939-1970s)
  - Calcium Chloride Plant (1965-1970)
- Foundry (1900s-1965)
- Detroit City Gas Company (1920s and 1930s)
- Packaging Plant(s) (1920s - mid 1970s)
- Boiler House (1920s-1981)
- Kreelon (1940s-1950s)
- High Pressure Laboratory (1940s-late 1980s)
- Carbose (1950s-late 1970s)
- Calcium Hydroxide Unit (in Calcium Carbonate Plant)(1966-1981)
- Iron Oxide Pigment Plant (in Calcium Chlorides Plant)(1978-1987)
- Elastogran Machinery Business (EMB) (Mid 1980s-1993)
- Windshield Adhesives Plant (1988-1993)
- Phosphate Production Unit (1990-1993)
- Small Miscellaneous facilities (i.e. blacksmith, stables, etc.)

North Works Plants that are presently in operation include:

- Corporate Research and Development Complex (1940s-Present)
- Pilot Plant (1940s-Present)

- Polyols Plant (1957-Present)
- Chemical Engineering Research Facility (1960s-Present)
- Vitamins Complex (1970s-Present)
- Steam Facility (1981-Present)
- Elastocell Plant (1986-Present)
- Engineering Plastics Compounding (EPC) Plant (1988-Present)
- Expanded Polyolefin (EPO) Plant (1990-Present)
- Thermoplastic Polyurethane (TPU) Synthesis Plant (1991-Present)
- Polystyrene Pilot Plant (1994-Present)

Other operations took place at North Works that were not part of, or controlled by the Corporation. These included the Packaging Plants located on the north end of North Works operated by Detroit Soda Products Company and the Detroit City Gas Company that leased a site at the North Works Facility.

1.3.2 Past Data Collection Activities

In 1986, BASF Wyandotte Corporation entered a Consent Decree with the Michigan Attorney General to address groundwater concerns at both the North Works and South Works. DNR studies during the early 1980s found contaminated soils and groundwater at the North Works. Since the major cause for concern was migration of the contaminants into the Detroit River, an overall approach of groundwater control was developed to prevent the flow of contaminated groundwater from reaching the Detroit River. A groundwater study was conducted by S.S. Papadopulos & Associates, Inc. and based on this information, a control plan was developed and submitted to the State of Michigan. This plan was accepted as the basis for remedial action.

The 1986 Consent Decree specifies remedial measures for the North Works as follows: (1) operate and maintain groundwater extraction wells and a treatment system for 30 years or until demonstrating that required concentration levels (in general, less than the detection limit) in each monitoring well have been achieved and (2) demonstrate that an inward

hydraulic gradient toward each groundwater extraction well system exists which is adequate to halt the flow of contaminated groundwater to the Detroit River. Monitoring requirements include (1) periodic measurements of water levels in piezometer and extraction wells, (2) sampling and analysis during years 26 through 30, and (3) sampling and analysis to demonstrate intent to discontinue.

Summaries of actions conducted at specific SWMUs and AOC are presented in Section 1.5 of this QAPP and in the Current Conditions Report.

Groundwater Extraction System

Fifteen 6-inch diameter groundwater extraction wells were installed in February, 1986 and replaced in June, 1988 (Figure 1-4). The replacement was necessary to alleviate decreasing well yields and to reduce the amount of sand entering the wells. Typical construction details are shown in Figure 1-5.

In addition to the extraction wells, 9 monitoring wells and 7 piezometers were installed to evaluate the system's performance. These wells are 2-inches in diameter. Typical construction details are shown in Figure 1-6.

Groundwater from each of the extraction wells is transferred by a central vacuum pump system with liquid ring seals to a surface knock-out tank where solids are removed. Each well operates on high/low automatic level control using electronic controls.

The primary elements of the treatment system are 2 downflow pressure vessels, each containing approximately 20,000 pounds of granular reactivated carbon. Groundwater is pumped to the carbon adsorption treatment system using centrifugal pumps with mechanical seals. Typically, the carbon beds are operated in a series configuration with the least-contaminated bed in the secondary position. Discharge from the primary bed is sampled weekly and analyzed for methylene chloride, chloroform, dichloroethane, and 1,2-dichloropropane (PDC).

Treated water from the carbon adsorption treatment system is discharged to the Wayne County POTW in accordance with permit number D-11311.

Since installation and operation of the groundwater extraction system, groundwater gradients are toward extraction wells. Groundwater extraction rates were initially as predicted but have decreased somewhat over the past several years. During calendar years 1987 through 1993, 20 million gallons of groundwater and the equivalent of 21,000 gallons of PDC have been extracted through the groundwater extraction system.

In addition to the groundwater extraction system, several factors may have influenced the natural groundwater flow pattern across the North Works since the original groundwater study was conducted:

1. Approximately 50% of the river frontage has been sheet piled to a depth of 35 feet. The remainder of the frontage is planned for sheet piling within the next few years. The primary purpose of this piling is dock stabilization, but it will redirect the groundwater flow path.

2. Much of the underground stormwater drainage piping on the site has been replaced with welded joint construction. Infiltration of groundwater into the storm drain systems has been reduced significantly for much of the North Works. This system upgrade reduces the groundwater directly transported to the river via Outfall 003.

3. Surface contours have been changed through grading operations at the North Works. The grade changes promote internal drainage.

1.3.3 Current Status

Based on documents reviewed for this facility and on the findings presented in the 1994 Consent Order, the following potential source areas are targeted for further investigation:

SWMU E	-	2 Million Gal per Day Impoundment
SWMU F	-	Waste Filter Cake Area
SWMU G	-	Two Nominal Rubble Staging Areas
SWMU H	-	Emergency Containment Pond
AOC 1	-	Area South of Polyols Plant
AOC 2	-	Old Coke Plant
AOC 4	-	North Tar Pit
AOC 5	-	Propylene Dichloride Spill Area
AOC 6	-	Tar Area (South End)
AOC 7	-	Prussian Blue Area

SWMUs A, B, C, D and AOCs 3, 8, and 9 will not be investigated. All these areas either are closed, are not waste management units, or are characterized fully. Details are presented in the CCR.

The release mechanisms included spilling, leaking, placing and/or leaching waste constituents into soils and groundwater. BASF has implemented several programs to control release mechanisms and to reduce the amount of contamination in soil and groundwater.

The chemicals listed at 40 CFR 264, Appendix IX are targeted in the Consent Order for investigation during the RFI. The list has been reduced somewhat in areas where BASF has adequate knowledge of waste products present (i.e., coal tar wastes at the Coke Plant).

1.4 PROJECT OBJECTIVES

1.4.1 Specific Objectives and Associated Tasks

Objectives

The overall objectives of the RFI as stated in the Consent Order are to describe the nature and extent of any releases of hazardous waste or hazardous constituents at the North Works,

and to gather necessary data to support a CMS. As described in Section 1.1.1 of this QAPP, the potential migration pathways for contaminant released at the North Works are limited to groundwater carrying dissolved contaminants off-site, non-point source stormwater runoff carrying suspended and dissolved contaminants off-site, and potentially contaminated soils contributing contaminants to groundwater and stormwater. So, the specific objectives described here are designed to investigate and define the nature, extent, movement and receptors of hazardous constituents at the North Works.

The specific objectives are divided into the following categories:

1) Define groundwater and surface water pathways, flow rates, and gradients.
2) Characterize the lithology and physical conditions of the subsurface.
3) Define and identify barrier conditions.
4) Identify and characterize potential receptor populations and their habitats for use in the HEA.
5) Characterize the physical and chemical properties of sediments in the Trenton Channel adjacent to the North Works and describe the patterns of sediment deposition, erosion, or movement.
6) Calculate the influence of the groundwater extraction system on natural groundwater flow.
7) Define background conditions in groundwater and soils.
8) Collect samples of media and measure chemical characteristics of groundwater and soils.
9) Compare chemical concentrations to background and to action levels.
10) Identify unpermitted discharge of contaminants to off-site locations.
11) Describe the physical and chemical characteristics of the individual SWMUs and AOCs.
12) Prepare the RFI report.

These specific objectives are consistent with the objectives of the Consent Order.

Tasks

The tasks that will be performed to fulfill the specific objectives are summarized below. Specific methodologies are consolidated as Standard Operating Procedures (SOPs). The SOPs for field tasks are compiled in Appendix B.

1) To define groundwater and surface water pathways, flow rates, and gradients.

- Verify the integrity of existing piezometers, monitoring wells, and extraction wells at the facility. If well casings or concrete pads are damaged, the well may need to be replaced.
- Install 19 new groundwater monitoring wells along the perimeter of the facility to provide more detail to the water table contour map. Planned locations are in Figure 1-7.
- Install 9 new groundwater monitoring wells and 4 new piezometers at interior locations to provide more detail to the water table contour map.
- Survey well locations for horizontal positions to within 0.1 ft and elevation of the top of casing to within 0.01 ft.
- Measure static water levels within 0.01 ft and map groundwater elevations and gradients using contouring procedures.
- Perform a pump test using the existing groundwater extraction system to calculate physical properties of the saturated zone (i.e., transmissivity, specific yield, conductivity, permeability).
- Prepare topographic maps with sewer lines and catch basins identified to describe the stormwater runoff pattern.
- Observe and describe stormwater run-off during a heavy rainfall.

2) Characterize the lithology and physical conditions of the subsurface.

- Review plant engineering drawings

- Review existing subsurface boring logs to identify the distribution of lithologic units to a depth of approximately 25 ft (depth corresponding to the top of a thick lacustrine clay).
- Supplement subsurface data with new boring logs as they become available.
- Prepare cross-sections that illustrate the distribution of lithologic units.
- Prepare maps that illustrate depositional areas (both natural on man-made), relief on the lake clay and isopachs of the fill, sand, and other units.

3) Define and identify barriers.

- Define barriers based on physical and hydrogeologic properties of subsurface materials (i.e., conductivity of 10E-8 cm/s or less).
- Review subsurface test results to identify barriers.
- Review available drawings to identify buried utilities, foundations, sewers that can act as barriers.
- Identify radius of influence for extraction wells.
- Place barriers on topographic and groundwater contour maps.

4) Identify and characterize potential receptor population and their habitats.

- Review literature on the aquatic and terrestrial habitats near the North Works and in the Trenton Channel.
- Identify potential protection standards.

5) Characterize the physical and chemical properties of sediments in the Trenton Channel adjacent to the North Works.

- Review literature on contaminants found in the Trenton Channel.
- Review literature to describe sediment depositional and erosional areas.
- Describe flow patterns in the Trenton Channel.

6) Calculate influence of the groundwater extraction system.

- Use 1984 groundwater contour maps as baseline conditions.
- Compare current groundwater contour maps to baseline conditions and describe differences.
- Compare quarterly groundwater contour maps from last three years to one another. Measure cones-of-depressions on water table to see if extraction system has reached steady-state conditions.
- Examine groundwater withdrawl data to estimate how well system operates, to predict groundwater recovery rates, and to plan the pump test.
- Calculate effect of extraction system in terms of reducing flow to Detroit River and other off-site areas.
- Combine volume of extracted groundwater with analytical data to calculate capture and reduction of contaminants in groundwater.

7) Define background conditions in groundwater and soils.

- Select background sampling locations for groundwater. Five proposed monitoring wells on western side of facility (RFIMW 24 through 28) and two existing wells (P-34-N and P-35-N) will be sampled. These locations were selected because groundwater flow historically was west to east.
- Groundwater samples will be analyzed for parameters listed at 40 CFR 264 Appendix IX.
- Groundwater samples will be collected monthly for three consecutive months and then the initial background calculations will be performed. Quarterly groundwater data from the background wells will be used to supplement the database used to recalculate background concentrations.
- For each parameter detected in groundwater from background wells, the background concentration will be calculated by following the statistical method presented in USEPA 1986 (mean plus three standard deviations).

- Select background locations for soils. Five proposed locations are shown on Figure 1-7, and they correspond to the five new monitoring well locations (RFIMW-24 through 28).
- Two samples of soil (SOP-02) will be obtained from each of the five boring; the first sample will be from the fill as identified by SSP & A (1984) at a depth of 1 to 3 ft, and the second sample will be from the sand underlying the fill at a depth of 6 to 8 ft. These depths were chosen because they should correspond to these lithologies.
- All samples will be analyzed for parameters listed at 40 CFR 264 Appendix IX (see Table 7-4).
- For each parameter detected at each soil horizon, the background concentrations will be calculated by following the statistical methods presented by the DNR (1994) which is arithmetic mean plus 3 standard deviations. If a parameter is not detected in every sample, the background concentration will be the detection limit.

8) Collect samples and measure contaminants in groundwater and soils.

- Samples of groundwater and soil will be collected as described in Section 1.5 of this QAPP.
- Samples will be analyzed for the parameters listed on Table 1-1 as described in Section 1.4.2.
- Data received from the analytical laboratory will be validated as described in Section 9.0. EPA requires that all data undergo validation by the RFI consultant.
- Data will be summarized and tabulated to facilitate use and inclusion in subsequent reports.
- Data will be subjected to selected statistical computations to estimate variances, confidence levels, and other parameters.

9) Compare contaminants concentrations to background and to action levels.

- The calculation of background concentrations is described at Task 7 of this section. The definition of action levels is presented in Section 1.4.2.

- If a contaminant is not detected in any media, it will be dropped from any further consideration.
- If a contaminant concentration in groundwater does not exceed background at every location, it will be dropped from any further investigations.
- If a contaminant concentration in soil does not exceed background in either of the two soil horizons (fill or sand), it will be dropped from any further investigations.
- Sampling locations where contaminant concentrations exceed action levels, background, or both will be identified on site maps.
- Contaminant concentration in fill will be compared to background concentrations for fill, and concentrations in sand will be compared to background for sand.

10) Identify unpermitted discharge of contaminants to off-site locations.

- From groundwater contour maps, identify areas where groundwater is leaving the facility.
- From groundwater analytical results, identify concentrations of contaminants that may be leaving the facility.
- From topographic maps, storm sewer maps, observations of stormwater runoff, and surface soil analytical results, identify concentrations of contaminants that may leave the facility.
- From sewer maps and groundwater analytical results, identify concentrations of chemicals that may infiltrate leaky sewer pipes and leave the facility.
- From investigations of the Trenton Channel and groundwater contour maps, identify areas where sediments may have been impacted from the North Works.

11) Describe the physical and chemical characteristics of the individual SWMUs and AOCs.

- Existing information as presented in the CCR will be supplemented with analytical and physical data collected during this RFI.

- Descriptions, conclusions, and recommendations will be prepared and included in the RFI report.

12) Prepare the RFI Report to address the following topics.

- Characterize the environmental setting.
- Characterize the nature of contaminants
- Identify and characterize the potential pathways of contaminant migration
- Identify and characterize the source(s) of contamination
- Identify and characterize contaminant plumes
- Define the degree and extent of contamination
- Identify actual and potential physical, human and ecological receptors and their habitats
- Support the development of corrective action objectives, protection standards and alternatives from which a corrective measure may be selected

Completion of Tasks 1 through 11 will provide adequate information to complete the RFI Report (Task 12). The RFI report may be divided into three volumes: the report of the investigation's findings, a health and environmental assessment, and a statement of corrective action objectives. The RFI report will draw conclusions as to the completeness of the work. If adequate data and information are gathered, the report will recommend proceeding to the corrective measures study, if warranted.

1.4.2 Project Target Parameters and Intended Data Usages

Field Parameters and Data Usage

The following list identifies the field monitoring equipment that will be used and the intended uses.

- Photoionization detectors (PID) or flame-ionization detectors (FID) to screen for organic vapors either in samples, at sample locations, or in the breathing zone (see HSP)
- Thermometers, conductivity meters and pH meters to aid in monitoring well development.
- Oxidation-reduction (Redox) meters to measure this potential in groundwater to aid with fate and transport calculations.
- Measuring tapes and field surveying equipment to identify sampling locations, measure samples, and find depth to groundwater.
- Dissolved oxygen meters to measure this concentration, to aid in calculations of fate, and to evaluate and design potential corrective measures.

All these data will be gathered in the field and recorded in the field log books.

Analytical Parameters and Usage

The target analytical parameters for this investigation are listed on Tables 1-2 through 1-4 and Table 7-4. Target parameter were selected specifically for each medium and each area as discussed in Section 1.5 of this QAPP. In summary target parameters are:

- Chemicals listed at 40 CFR 264 Appendix IX for groundwater samples from all perimeter monitoring wells, wells PM2NB and PM3NB, and for soil samples from SWMU H and portions of AOC 5.
- Chemicals listed at 40 CFR 261.24 and Table 1-2 for soil samples from SWMUs E, F and G.
- Chemicals listed on Table 1-3 that are indigenous to coking plants and coal tars for soils from AOCs 2, 4 and 6 and for groundwater from wells RFIMW-14, RFIMW-15, RFIMW-16, RFIMW-20, PM1NA, PM2NA, PM1NC, and PM2NC.
- Chemicals listed on Table 1-4 that are indicative of Prussian Blue wastes for AOC 7.

Three groups of chemicals will be excluded from the analytical parameters. These are chlorinated dioxins, chlorinated furans, and organophosphate pesticides. Organophosphates were never used or manufactured at the North Works and there are no reasons to suspect that they are present. Likewise, there are no reasons to suspect that chlorinated dioxins or chlorinated furans would be present because there were no processes that used them, and it is not expected that any process would have produced them.

These data will be compared to action levels or to background levels, as appropriate, with the ultimate objective being to calculate acceptable risk-based concentrations for contaminants detected on site.

Action Levels

Michigan's Type C Groundwater/Surface Water Interface (GSI) Values are proposed as action levels. The GSI valves are listed in Michigan Environmental Response Act (MERA) Memorandum #14, revision 1 dated June 21, 1994, and reproduced in Appendix A. The GSI values will be used to identify contaminants of concern; that is, if a contaminant is found at concentrations above its GSI value, then it will be examined for potential impact to human and environmental receptors. If a contaminant is not found at concentrations above its GSI value, then it will not be examined for potential impact in the HEA.

GSI values are presented for both groundwater and soil. The soil value is 20-times the groundwater value, because the EPA and DNR assume a 20 to 1 dilution when chemicals leach from soil to water. For chemicals not listed in MERA Memorandum #14, acceptable GSI values will be calculated (when needed) from published toxicity, reference dose, and/or slope factors by following procedures defined in the Administrative Rules for Act 307 (DNR 1990).

1.4.3 Data Quality Objectives (DQOs)

EPA Guidance (U.S. EPA 1987a, 1987b) supports the concept of tailoring the analytical level to the intended use of the data. In general, the five analytical levels are:

- Level I - field screening or analyses using portable instruments;
- Level II - field analyses using more sophisticated portable analytical instruments, possibly setup in a mobile laboratory;
- Level III - analyses performed at an off-site geotechnical or analytical laboratory but without the validation or documentation procedures required of the Contract Laboratory Program (CLP) Level IV analyses;
- Level IV - CLP (or CLP-like) routine analytical services; and
- Level V - analysis by non-standard methods;

Different data usages require different levels of data quality. Data validation procedures are discussed in Section 9.0 of this QAPP. In order to meet the objectives of the Consent Order, the following qualitative DQOs were identified:

1. Screening (DQO Level I): The following measurements will be used under DQO Level I to screen and obtain basic site characterizations:

- Surface Water: pH, temperature, specific conductance, redox potential, dissolved oxygen and water levels/elevations;
- Groundwater Samples: pH, temperature, specific conductance, redox potential, dissolved oxygen and water levels/elevations, and
- Soil Samples: physical descriptions, penetration rates, and soil organic vapor.
- Compile or acquire basic geologic and hydrogeologic information such as existing water table maps, boring logs, and groundwater extraction rates. These data will be used to evaluate migration pathways and to characterize background conditions at and around the facility.

- Identify changes in groundwater flow patterns from the patterns which had been used for the existing groundwater extraction and remediation system design. Data acquisition will focus in the vicinity of sewers and the river to meet the objectives of the Consent Order.

The data acquired under DQO Level I will be used to detect changes in groundwater characteristics between sampling rounds, to describe basic physical properties of media investigated, and to verify adequate purging of monitoring wells. Water level elevations will be measured to map the water table and to calculate groundwater gradients by following standard contouring protocols.

2. Field Analyses (DQO Level II): The following measurements will be used under DQO Level II. They will be used to generate data to evaluate physical properties of the groundwater bearing units:

    - Surveyor's instruments including theodolite, levels, and range finders
    - Pressure transducers that measure fluctuations of fluid head in monitoring wells.
    - Data loggers (such as the Hermit 1000B) that collect and record data from transducers.

    DQO Level II data will be used to locate sampling points and to assess the distribution of porous and permeable layers at the facility.

3. Off-site Laboratory Analyses (DQO Level III): Level III DQO will be used for characterizing waste streams, for acquiring basic geotechnical information by following American Society for Testing Materials (ASTM) methods, and for identifying hazardous wastes. The media anticipated to be sampled are soils and other solids or semi-solids (i.e., sludges) that may be disposed of during the RFI. Analytical parameters will be limited to those that can display a toxicity characteristic

(40CFR 261.24). Laboratory SOP names and their equivalent EPA preparation also are presented in Tables 7-1 and 7-2.

Additionally, existing analytical data on chemicals in soil (i.e., PDC at AOC 5) are assumed to be DQO Level III. These data show the distribution of chemicals in the subsurface, but documentation is lacking to consider the data for use in the HEA.

4. CLP-RAS (DQO Level IV): SW-846 analytical methods with an increased level of QA/QC will be used in place of CLP methodologies for sample analyses. The data will be presented in CLP-type deliverables. Data validation procedures are performed according to U.S. EPA recognized protocol. The methods and target reporting limits are listed in Section 7.0.

   Additionally, all published analytical data obtained from an EPA or a DNR source that pertains to sediment quality in the Detroit River will be considered DQO Level IV.

5. Non-Standard (DQO Level V): DQO Level V data are planned to be used to evaluate old filter cake for self-heating capabilities. The SOPs are presented in Appendix E.

1.5 SAMPLE NETWORK DESIGN AND RATIONALE

The sample network design and rationale is described in this section. Sampling objectives, tasks and data usage for the site-wide groundwater investigation, the sediment investigation, each SWMU and each AOC are discussed in the following sections.

Sample matrices, analytical parameters, number of samples, sample locations, and rationale are described individually for each area being investigated. Maps showing intended soil and groundwater sampling locations are included as figures at the end of this section. Depending on the nature of conditions encountered in the field, some of the locations may be changed.

The Field Manager is responsible for identifying the sampling locations in the field. His duties are described in Section 2.0 of this QAPP.

Table 1-1 is a sample network summary table for this investigation. The objectives for the entire RFI are presented in Section 1.1.1 of this QAPP; specific objectives for each task are described in the following sections.

1.5.1 Groundwater Investigation

Background

The hydrogeological conditions at the North Works are described in Section 3.0 of the CCR. The major observations are summarized below:

1) Groundwater is not a source of potable water in the area. BASF had used groundwater for non-contact cooling water in the transparent iron oxide (TIO) plant. This use was discontinued.

2) Groundwater occurs in the fill and shallow unconsolidated lacustrine deposits at depths beginning a few feet below the ground surface.

3) Natural groundwater flow mapped in 1984 (SSP&A 1985) was west to east and toward the Detroit River.

4) A groundwater extraction and treatment system has operated at BASF since 1987. The system was built in response to a Consent Decree with the State of Michigan. Approximately two to three million gallons of groundwater are extracted and treated each year. Water table contours show cones-of-depression around the extraction wells.

5) Laboratory analyses on samples of groundwater indicate that organic compounds are the major contaminants of concern; however, analyses have been somewhat limited.

Objectives

During the groundwater investigation, all existing monitoring wells, extraction wells and piezometers as well as all monitoring wells and piezometers installed during this RFI will be used to measure groundwater elevations and to monitor in situ testing of the saturated zone. Monitoring wells also will be used to measure dissolved oxygen, redox potential and pH. These observations will be included in the RFI report to characterize the groundwater system and to aid in planning a corrective measure.

Selected wells are chosen for sampling and analyses of groundwater. The wells selected for sampling and the rationale are identified throughout this section and the following sections.

The objectives for investigating groundwater on a site-wide basis are:

1) To calculate groundwater flow velocities, gradients, and directions. The information will show where groundwater enters and exits the facility. Transmissivity, storage capacity, and other physical properties of the saturated zone will be calculated or measured to help plan a corrective measure.

2) To measure the influence of the extraction system.

3) To identify background concentrations of contaminants in groundwater from wells RFIMW 24 through 28, P-34-N, and P-35-N.

4) To identify nature and extent of contaminants in groundwater at the facility boundary and near SWMUs and AOCs.

5) To support development of Preliminary Corrective Action Objectives.

Tasks

1) Drill 28 borings (SOP-02) to a depth at least 2 ft into the lacustrine clay unit. Soil descriptions will be recorded in the field log book and on boring log forms. Install monitoring wells within the borehole (SOP-05) and develop all wells (SOP- 07).

   Twenty-eight monitoring well locations were chosen because, when combined with the existing wells, a double line of wells will monitor groundwater on the north, east and south sides of the facility at a spacing of approximately 500 ft. This interval should be adequate to identify contaminants in groundwater at these facility boundaries. The upgradient wells are approximately 1000 ft apart and are spaced evenly across to front of the facility.

2) Soil samples for chemical analyses will be obtained from selected borings only (see Sections 1.5.11, 1.5.13, & 1.5.14).

3) Install staff gauges at the Detroit River on both ends of the North Work's dock. Survey top of casing locations and elevations for the 28 new wells and all existing piezometers, monitoring and extraction wells and the staff gauges.

4) Measure water elevations in Detroit River. Measure static water levels (SOP- 06) and calculate elevations of water table. This task will be performed once every three months for one year.

5) Purge and sample the perimeter and background wells listed on Table 1-1 (SOP-18). Samples will be analyzed for chemicals listed on Table 7-4

6) Conduct a pump test to calculate hydrogeological and other physical properties of the saturated zone (SOP-21). The pump test will be performed by turning off the extraction wells for approximately 72 hours, measuring water table recovery, turning

on the extraction wells, and measuring water table draw down. Observations of the water table will be recorded from wells at the facility.

7) Prepare maps of the water table by following contouring methods. Calculate groundwater gradients, flow directions and velocities. Identify areas where groundwater enters the facility and areas where groundwater exits the facility. Calculate volumes of groundwater entering and leaving the facility. Identify radii of influence for extraction wells.

8) Calculate concentrations of contaminants entering the facility along the west boundary (background conditions) by following method in USEPA 1986.

9) Calculate concentrations of contaminations and volumes of water leaving the facility other than through extraction wells. Compare concentrations to background and action levels.

10) Compare current groundwater flow directions, volumes, and gradients to baseline conditions described by SSP&A (1984, 1985, & 1988) and identify changes. Some of the changes may be quantified. Calculate net reduction in groundwater flow to off-site areas (i.e., the Detroit River).

11) All cuttings generated during well installation will be placed on plastic, covered and left near the bore hole initially. All cuttings will be collected and placed in a roll-off box by the time well installation is completed. Disposition of cuttings will depend on the results of hazardous waste characterization (see SOP-04).

12) Water generated during well development, purging, sampling and decontamination will be placed in suitable containers and moved to and placed in the treatment system for the groundwater extraction system (SOP-12).

Data Usage

Two sets of data will be obtained and used during the RFI: Physical data and analytical data.

Physical data will consists of measurements and observations. Data quality objectives are set at Level I and Level II. The data will be used to map the water table, calculate the hydrogeological properties of the saturated zone (i.e., transmissivity) and identify groundwater flow rates and directions.

Analytical data will consist of laboratory-supplied test results describing the chemicals in groundwater. Data quality objectives are set at Level IV, and results will be validated by the RFI Consultant. Results will be compared to Action Levels and utilized in a health and environmental assessment. The need for Preliminary Corrective Action Objectives will be based on these data.

1.5.2 SWMU A - Former 25,300 Gallon Container Storage Area

Background

As described in Section 6.0 of the Current Conditions Report (CCR), this unit was operational between May 1978 and March 1987 and was used as a storage pad for less-than-90-day accumulation of hazardous waste containers (typically less than or equal to 55- gallon containers) prior to shipment off-site for treatment or disposal. This storage area was included on the Part A permit application dated November 1980. BASF received closure from the DNR for this area during June 1991. Since closure of the unit, the concrete pad has been used for product and raw material storage associated with the Urethane Applications unit. The intended future use of the area is for non-waste management practices.

BASF believes that the existing groundwater extraction system is sufficient to satisfy the post-closure requirements. On June 27, 1991, the DNR-WMD concurred with BASF on the

closure approach and recognized the status of the container storage area as closed but denied a determination of clean closure. The area is subject to 30-years of post-closure care and groundwater monitoring per 40 CFR 265.117. Implementation of a 30-year post-closure program for the storage area that is parallel to the 30-year remedial action program currently underway, pursuant to the 1986 Consent Decree, is not necessary.

Conclusion

In accordance with the closure granted by the DNR, this former SWMU is subject to continuing groundwater monitoring. The groundwater monitoring program for this area corresponds to the site-wide groundwater extraction and treatment program currently operating. No further action is planned for this SWMU during this RFI.

1.5.3 SWMU B - Research & Development Waste Crib

Background

As described in Section 7.0 of the CCR, this 100-cubic yard capacity storage area is a 6.5-ft by 26-ft concrete pad located adjacent to a storage building near the Research and Development Complex. Past and present BASF practices are to utilize the container storage area for the accumulation of hazardous wastes, for less than 90 days. Wastes are contained in 55-gallon containers and typically consist of waste solvents from non-specific sources and ignitable wastes generated exclusively from chemical research, engineering, and analytical activities. Hazardous waste accumulated in the area have been, and continue to be, transported off site to a licensed treatment, storage, and disposal facility (TSDF) within 90 days of being generated.

Interviews with BASF employees and review of documentation indicate that there have been 4 spill incidents during the period from 1980 to 1992. In each of the cases, the spillage was minimal and was cleaned up with absorbent material. There is no indication of a hazardous

waste spill incident that has or will create and adverse impact on human health or the environment.

Conclusion

As described in the CCR, this unit is operated as a waste accumulation area for less than 90-day periods in accordance with federal and state hazardous waste handling regulations. Weekly inspections are conducted in accordance with RCRA. No releases have occurred from this unit and no further action is planned for this unit during the RFI.

1.5.4 SWMU C - Central Waste Accumulation Storage Area

Background

As described in Section 8.0 of the CCR, this unit was closed clean in 1993. The former central waste accumulation storage area (CWASA) was managed as a less than 90-day hazardous waste accumulation storage area. The CWASA was used for the accumulation of 55-gallon containers prior to transportation offsite to a licensed treatment or disposal facility. There are no records of releases from the CWASA.

A report was prepared September 16, 1993 to document clean closure of the CWASA in accordance with 40 CFR 265.111 and 265.114 as required by 40 CFR 262.34 and Rule 299.9306 of Michigan Act 64 of 1979. Closure activities consisted of an extensive surface cleaning of the CWASA and surrounding areas followed by three separate water rinses. After cleaning, a sampling and analyses were performed to verify that the CWASA was successfully decontaminated and to assess if waste management practices during the operation of the CWASA had impacted the accumulation area.

Conclusion

This unit was closed clean during 1993 as described in the CCR. Waste storage no longer occurs in this unit; therefore, no further action is planned during this RFI.

1.5.5 SWMU D - 4,000 Gallon Acetic Acid Tank

Background

As described in Section 9.0 of the CCR, this unit now stores heptane (a raw material) and is not a waste accumulation unit. The tank is a glass lined pressure vessel installed in a diked enclosure. There has never been a leak from the tank. The vessel is included in the Vitamin Plant's preventive maintenance program. In 1980, this tank was included in the Part A application to the DNR because it occasionally stored waste acetic acid. In 1987 the use of this tank for handling acetic acid was discontinued and the tank was later converted for use as a storage tank for heptane, a raw material in the Vitamin E manufacturing process. In December 1988, after consultation with the DNR, BASF requested amendment to the Part A by deleting reference to this tank. The DNR expressed agreement and indicated that the tank will be taken off the Part A upon receipt of the necessary documentation from BASF.

Conclusion

This unit stores heptane and is not a waste accumulation unit. There have not been any spills or releases from this tank. No further action is planned for this unit during the RFI.

1.5.6 SWMU E - Polyols Pond

Background

As described in Section 10.0 of the CCR, the Polyols Pond is constructed of earthen dikes lined with clay and contains a concrete wall that separates the pond into two sections. The

bottom liner for the pond was constructed by compacting two 1-ft thick layers of clay. The Polyols Pond collects wastewaters from several sources; process and stormwater from the Polyols Plant, the EPO plant, the Steam Facility, and noncontact cooling waters from several equipment sources. The Polyols Pond also provides surge capacity for emergency upsets that may occur at the Polyols Plant.

Prior to discharge, the wastewater is neutralized as necessary with sulfuric acid and discharged into the pond. The wastewater is then combined with additional noncontact cooling water and stormwater runoff. The wastewater is then discharged through a diffuser pipe to the Detroit River via Outfall 001. This permitted discharge is regulated under the NPDES program. There are no records of releases from the Polyols Pond; however, the discharge limits for some of the parameters listed in the NPDES permit have been exceeded on occasion.

Sediment accumulates on the bottom of the pond that occasionally requires removal and disposal at a licensed disposal facility. The sediment is tested to assess hazardous characteristics prior to disposal. The last time the sediments were sampled, chemical constituents were not detected at concentrations requiring the sediments to be classified as RCRA hazardous waste. Analyses included RCRA characteristic testing for ignitability, corrosivity, and toxicity.

Objective

The objectives for conducting an investigation at SWMU E are:

1) to test the Polyols Pond sediment for RCRA hazardous characteristics,

2) to detect leakage from the Polyols Pond, and

3) to evaluate the potential for impact to the groundwater.

Tasks

This section describes the tasks, procedures, decision points and rationale for investigating sediment and groundwater at SWMU E.

1) During late 1995 or early 1996 (but not later than 1996), sediment samples will be collected (SOP-08), described and analyzed for hazardous waste characteristics. The analytical results will be reported in the RFI report.

2) Four sediment samples will be collected from each pond at locations shown on Figure 1-8. The number of samples is consistent with previous sampling for disposal characterization. Hand operated samplers will be used (SOP-08). The samples will be combined into two composite samples (one for each pond). Samples will be analyzed for hazardous waste characteristics (see Table 1-2).

3) Four piezometers will be installed (SOP-05), one on each side of the Polyols Pond, to assess possible interaction between the pond and the groundwater. Based on maps in SSP&A 1984, four locations should be adequate to detect a change in groundwater elevations.

4) Three monitoring wells will be installed (SOP-05) in the vicinity of the Polyols Pond as part of the site-wide groundwater investigation.

5) The elevations at the top of the piezometer risers and the top of the monitoring well casings will be surveyed and tied in to the site-wide elevation network (SOP-20).

6) Once a month for three months and then on a quarterly basis for a period of one year, water levels will be measured in the four piezometers, the three monitoring wells, and at the staff gauge at the river to assess the seasonal fluctuations of the elevations.

7) Water level data will be plotted on a groundwater elevation map and compared to data in historical documents (i.e., SSP&A 1984, 1985) and in previous quarters.

Data Usage

Mounding of the groundwater surface in the vicinity of the Polyols Pond would be possible evidence of leakage from the Polyols Pond and a potential impact to groundwater. If mounding of the groundwater is detected, groundwater samples will be collected (SOP-18) from the four piezometers and three monitoring wells and analyzed for constituents on the Appendix IX list (Table 1-1). Results from upgradient wells will be compared to results from downgradient wells to assess any chemical impact.

Trends on the water table measured by SSP&A (1984, 1985, 1988) will be compared to trends measured during the RFI. The intent is to identify mounding of the water table at the Polyols Pond if it is present. A mound on the water table will be defined as a significant ($\alpha = 0.05$) lack of fit to a significant linear regression. Significance will be calculated through an analysis of variance (ANOVA) as defined and explained by Davis (1973).

If hazardous constituents are not found in the pond sediment and groundwater mounding is not found, then no further actions will be necessary at the Polyols Pond. Groundwater mounding alone may not indicate leakage because buried water pipes run through this area. Mounding will indicate the need for further investigations during a subsequent phase.

1.5.7 SWMU F - Filter Cake Disposal Area

Background

As described in Section 11.0 of the CCR, this area was used as an above grade disposal area for spent Britesorb® filter cake, a magnesium silicate filter aid used to filter polyols. Individually, Britesorb® and polyols are RCRA non-hazardous, but at the time of disposal, may have been spontaneously combustible under certain conditions. Deposits of spent filter

cake were interbedded with soda ash, sodium bicarbonate, lime wastes, clinker and ash from the North Works boilerhouse. These secondary inorganic materials are not RCRA hazardous wastes. Filter paper and filter cartridges from other polyol filtering applications also were buried in this area. In 1979, on-site disposal operations ceased, and the surface of the pile was covered with topsoil and graded to promote vegetation and drainage. BASF estimates that 60,000 cubic yards of material may have been deposited at SWMU F.

The only potentially hazardous exposure to filter cake involves direct contact with potentially combustible material at its point of burial. Migration, through soil, surface water, or groundwater is not a method of spreading this substance.

Objective

The objective for conducting an investigation at SWMU F is to assess the potential RCRA hazardous characteristics of the spent filter cake deposit. If hazardous characteristics are found, an additional objective will be to identify the lateral and vertical extent of the filter cake deposit.

Tasks

This section describes the tasks, procedures, decision points and rationale for investigating the waste deposit in SWMU F. Figure 1-9 illustrates the position and potential sampling locations for SWMU F.

1) Aerial photographs will be used to identify the probable limits of the filter cake. The distribution will be plotted on a map of the facility, and a 100-node grid will be overlain on SWMU F. A random number generator will be used to select 10 locations for boring and sampling. Ten samples will be adequate to calculate representative means and standard deviations.

2) Test borings will be completed to a maximum depth of 15-ft below grade or 2 ft into soils below filter cake, whichever is shallower. A hydraulic rig (SOP-09) will be used to collect samples for TCLP-analyses of chemicals listed on Table 1-2. Fifteen feet is chosen as a most likely maximum depth because relief in this area is not high enough to allow more than approximately 15 ft of filling. Samples will be collected continuously from the surface to total depth of the boring. Samples from the test borings will be examined visually for the presence of filter cake, filter paper and filter cartridges. One 2-ft sample of filter cake will be selected from each boring for analyses. The filter cake deposits and the process that generated them was fairly similar during the time deposition occurred at SWMU F, so the selection of a sample from a boring will not make a difference.

3) If a boring does not encounter at least a one-foot thick layer of filter cake, a new location will be selected randomly.

4) If analyses show that hazardous waste are present within the filter cake, the hydraulic rig will probe the edge of the SWMU to verify the horizontal extent. Less than one-foot of filter cake will be defined as the edge. Based on the suspected size of SWMU F, a 50-ft spacing will be adequate to identify the lateral extent of filtercake.

5) If filter cake is found in a boring, a new boring will be advanced 10-ft outward (or inward at the discretion of the field manager) from the previous location. This procedure will be repeated until the edge is encountered. Additional samples will not be collected for analyses.

6) The ten representative samples collected for submittal to the laboratory (SOP-01) will be analyzed for RCRA hazardous waste characteristics (Table 1-1) and spontaneous combustibility.

7) Analytical results will be evaluated by following guidance published by the DNR (1994, Attachment 2). Because the objective of the sampling is to identify potential

contamination rather than verify the area is clean, a confidence level of 80% is selected ($\propto \approx 0.2$).

8) Analytical and statistical results will indicate if materials placed here previously contributed to soil contamination.

Data Usage

Analytical results will show if the wastes within SWMU F are RCRA hazardous or spontaneously combustible. Data from boring logs will illustrate the horizontal and vertical extent of the materials. If the materials do not exhibit a characteristic of a RCRA hazardous waste, then no further actions will be necessary. If the materials display a RCRA hazardous characteristic, then potential corrective measures will be evaluated during the CMS.

1.5.8 SWMU G - Two Nominal Rubble Staging Areas

Background

As described in Section 12.0 of the CCR, the area ascribed to these two units had been built up by industrial fill over the period from the 1890s to the 1980s. The reference to storage of demolition rubble in the Consent Order seems to reference a time when the Soda Ash Complex was dismantled and the area was used to stage debris (see site general history). Concrete, steel and other debris were piled in this area prior to removal from the North Works. Some soda ash, lime fines and cinders may have been present as residual material in hoppers or bins, but these materials are not RCRA hazardous waste. The ground surface elevation before and after the period referenced did not change appreciably. Some rubble such as bricks, concrete and reinforcing steel can be found in the top layer of soil in the area.

The area is vacant and was graded in the past 10 years to improve drainage. Top soil was added to help grass grow.

Objective

The objective for conducting an investigation at SWMU G is to confirm that no residual RCRA hazardous constituents, as measured by the toxicity characteristic leaching procedure, remain as a result of the debris staged through here.

Tasks

The following section describes the tasks, procedures, decision points and rationale for investigating soils at SWMU G.

1) Historic aerial photographs and drawings will be examined to identify the location of the former rubble piles as accurately as possible.

2) Once the locations of the former piles are known, they will be drawn on a map and a grid will be superimposed on the piles. The grid will contain 100 nodes. Ten percent of the nodes will be selected for sampling by using a random number table. Ten samples will be adequate to calculate means and standard deviations.

3) Grab samples of soil will be obtained from the ground surface (SOP-08) because rubble was placed on top of the ground surface. Sampling depth will be approximately 6 to 12 inches.

4) If the sampling team members find that new topsoil was placed over the former ground surface, the topsoil will be moved away prior to collecting the sample of soil. The field geologist will use best professional judgment when deciding if topsoil will be removed.

5) Samples of soil will be packaged shipped to the laboratory (SOP-01), and analyzed for toxicity characteristics (Table 1-1).

6) Analytical results will be evaluated by following guidance published by DNR (1994, Attachment 2). Because the objective of the sampling is to identify potential contamination rather than verify that the area is clean after being remediated, a confidence level of 80% is selected ($\alpha = 0.2$).

7) Analytical and statistical results will indicate if material previously staged through this area contributed to soil contamination and if a potential contribution could affect groundwater.

Data Usage

If analytical results show that the TCLP regulatory limits are not exceeded then further investigative work or corrective measures will not be necessary. If analytical results reveal the presence of chemicals above regulatory limits, then BASF will conduct a supplemental investigation to define the extent of contamination. The work would include additional biased sampling and analyses at the edges of the former rubble piles to identify the lateral extent of contamination. Analytical parameters would be selected from any exceedances identified earlier. Samples will be collected at locations 10 ft outward from previously identified contamination. After analyses, another decision will be required to assess if the limit of contamination was identified or if additional sampling and analyses are necessary.

All results will be documented in the RFI report.

1.5.9 SWMU H - Emergency Containment Pond

Background

Section 13.0 of the CCR describes the Emergency Containment Pond and Historical routing to Outfall 003 (SWMU H). This feature extends through the center of the facility (Figure 1-10).

The origin of the system traces to the late 1800s and the dewatering and filling of the original Detroit River marshland. Portions of the system were used as drains for the pre-1920s Soda Ash complex on the west side of the North Works. Fragmental records indicate that there was originally only one drainage system for that complex so the system would have handled stormwater, noncontact cooling waters, contact waste waters and sanitary drainage as a combined stream. By the time the ditch system had reached the final configuration designated as SWMU H, the primary effluents were stormwater, noncontact cooling water from the main office and research building, and contact wastewater from the Pilot Plant and later from the Chemical Engineering Building. Additionally, some drainage from processing areas within the Soda Ash Complex entered the system in the eastern half of the system. No portion of the system was lined. It was dredged periodically to maintain flow.

The containment pond was equipped with valves in the entrance and discharge pipes to isolate spills from the Pilot Plant within the system. Portions of the ditch system actually were drainage pipes to facilitate roadways over the ditches and for flow control purposes. Over the years, the Pilot Plant manufactured or handled a wide variety of materials including polyols, urethane latex, isocyanates, amines, magnesium silicate, methanol, methylene chloride, isopropyl alcohol, and Basalin (a herbicide). There is no record of the number of times this containment was employed to contain spills, although a Basalin spill is know to have occurred in the immediate area. No records have been found detailing the use of any of the containment features (primarily weirs) in the downstream impoundments to isolate problems from any of the sources; however, it is generally acknowledged that such isolations did occur. The entire open drainage system was operated under the facility's NPDES permit when such permitting came into existence.

Beginning in the early 1980s, this ditch system was gradually filled in and replaced with a steel piping system with welded joints to prevent infiltration of groundwaters into the Outfall 003 discharge.

There has not been any investigations to identify chemicals potentially present within SWMU H.

Contamination from AOC 5 is known to be present near SWMU H. Propylene dichloride (PDC) spillage during the 1970s entered the soils and groundwater. BASF conducted a subsurface screening survey and found PDC concentrations up to 10,000 ppm in soil (see Appendix J of the CCR). The elevated concentrations of PDC may interfere with the analytical methods used to measure low concentrations of other VOCs; however, data obtained during analyses for semi-volatiles, herbicide/pesticides, and metals should be of adequate accuracy and precision to conclude if these groups of contaminants are present.

Objectives

The objectives for conducting an investigation at SWMU H are:

1) To confirm the location of the former containment pond and ditch.

2) To identify contaminants that may be in soils as a result of discharge to the former containment pond and ditch.

3) To identify and characterize potential migration pathways qualitatively, if contaminants are present.

Since investigations have not been performed at SWMU H previously, proposing a specific plan to define the extent of potential contamination is premature. If analytical results indicate the presence of hazardous constituents above action levels, then BASF will conduct a supplemental investigation to define the extent of contamination so that potential corrective measures can be evaluated. The scope of a supplemental investigation will include completing test borings spaced approximately 10 ft outward from previously detected contamination and to a depth sufficient to delineate the lateral and vertical extent of impacted soil. Soil samples will be collected for analyses of chemicals found to exceed action levels,

and soil samples will be submitted to the analytical laboratory to confirm that the extent of impacted soil has been found. The need for additional monitoring wells in this SWMU would be evaluated based on the data generated from the site-wide groundwater sampling program. The proposed sample locations and rationale for a supplemental investigation will be submitted to the EPA as an addendum to this QAPP.

Tasks

This section describes the tasks, procedures, decision points, and rationale for investigating potential contamination in soils and groundwater at SWMU H.

1) Confirm the location of the former containment pond and ditch system. The locations of the former containment pond and ditches are known fairly accurately because drawings dating back to the 1920s show these features clearly. However, since they now are buried and a steel drain pipe is near the former ditch, a limited investigation aided by BASF plant engineers is planned to ensure that the location of the pond and ditches are known. The perimeter of the pond and ditch system will be flagged prior to drilling and soil sampling.

2) Lay out locations for ten transects across segments of the pond or ditches. Ten transects were selected at a spacing of approximately 200 ft so that each ditch and pond segment will be sampled at least once; the longer segments will be sampled twice. This spacing is adequate to characterize the nature of contamination because:

   - Chemicals would have spread over most of the pond area due to their liquid state.
   - Sampling will be biased toward the places most likely to exhibit contamination.

3) At each of the ten transects shown on Figure 1-10, two soil borings locations will be staked. The locations will be approximately 10 ft apart and oriented perpendicular to the former ditch line.

4) Use a hand level and stadia rod to measure relative surface elevations at the two borings.

5) Advance the borings using a hydraulic rig and collect soil samples continuously (SOP-09), to a depth of 20 ft. This depth exceeds the maximum known depth to the base of the ditches or pond.

6) Screen soil samples for the presence of volatile organic compounds with a PID or FID (SOP-11), examine and describe the subsurface materials. Record the sample descriptions on a boring log. Because the fill material in the ditches and pond was placed more recently than the older surrounding materials, the field geologist should be able to identify the bottom of the newer fill material that corresponds to the base of the ditch. Collect a sample of the older surrounding material from the base of the former ditch for potential laboratory analyses.

7) Calculate the elevation of the base of the ditch in each boring. Select the deeper of the two samples of older surrounding material at each transect for analyses at the laboratory. Because liquid in the pond and ditches would collect at the low spots, obtaining soil samples from the low spots increases the probability of finding contamination if it is present. Conversely, if contamination is not found where it is most likely to occur, then we can conclude that contamination is not present.

8) Package the soil sample selected and submit for analyses for the chemicals listed at 40 CFR 264 Appendix IX (SOP-01). If levels of VOCs are at least 20 ppmv greater than background as measured with the PID or FID for the soil samples submitted, notify the laboratory on the chain-of-custody. This notification will aid the laboratory with sample preparation.

9) Note intervals that may be conducive to migration of fluids and record their depth on the boring log. These intervals may appear more porous or may have a higher moisture content than surrounding intervals. These qualitive observations will be used to supplement the quantitative information gathered during the site-wide groundwater investigation.

10) Compare analytical results to background concentrations and to action levels.

Data Usage

Data obtained during the investigation at SWMU H will be used to:

- Identify chemicals within the former ditches;
- Estimate the ability of the chemicals to migrate in the groundwater or to be contacted at the surface.
- Select sample locations for a subsequent phase investigation to measure the extent of chemicals from this SWMU if chemicals are detected above action levels.

Information will be evaluated along with data collected at AOC 5 (see Section 1.5.14) to assess the need for a corrective measures study and to prepare preliminary corrective action objectives.

1.5.10 AOC 1 - Area South of Polyols Plant

Background

As described in Section 14.0 of the CCR, this area is being evaluated by the Toluene Remediation Investigation Project (TRIP) that began in March 1992. Hazardous constituents present in this AOC include styrene from the Polyols Plant, benzene, toluene, ethylbenzene, and xylenes (BTEX) from both the former Coke and by-products plant and the North Tar pit. The purpose of the TRIP to gather information necessary to design an in-situ remedy

for contamination in shallow soils around the Polyols Plant. Groundwater Technology Inc. (GTI) of Farmington Hills, Michigan is the contractor for the project. The investigation phase of the TRIP and a bioremediation feasibility study have been completed. Tasks remaining to be completed are submittal of the subsurface investigation report and design of the remedial system. The TRIP is expected to be completed during 1995.

Conclusion

This area is the site of the on-going TRIP as described in the CCR. This interim measure is in progress; therefore, no additional work is planned during the RFI. The data, information, and results from the TRIP will be reviewed during the RFI and incorporated into the RFI report as appropriate.

1.5.11 AOC 2 - Old Coke Plant

Background

As described in Section 15.0 of the CCR, for many years Kopper's process Coke ovens and a by-products plant operated in this area. During their investigation in 1981, EPA found the area formerly occupied by this plant to be contaminated with organic compounds such as toluene, naphthalene, phenols and other compounds typical to the coking process (Table 1-3). Organic compounds have been detected in both the soil and groundwater at this AOC. The occurrences of waste materials is not anticipated to be uniform but probably will change from place to place. The 1986 MDNR Consent Decree intended to address this area. The TRIP is in progress adjacent to AOC 2.

Efforts to prevent migration of contamination from this area include controlling surface drainage and redirecting groundwater flow. The surface drainage control program collects surface water and passes it through a carbon filtration treatment system. Welded-joint drainage pipe was installed to prevent infiltration of groundwater into the storm sewer

system. Two extraction wells, E14NC and E15NC, withdraw groundwater from the vicinity of this AOC for treatment.

Objectives

This AOC is within an active part of the North Works facility. It is operated under the control measures stated above to prevent contamination from reaching the Detroit River either through drainage to outfalls or migration in groundwater. Evaluation of corrective measures for this AOC will be on an area-wide basis. Emphasis will be placed on evaluating the groundwater and surface water control system currently in place or under development at AOC 1 and on improving the systems.

The objectives of conducting an investigation in AOC 2 are:

1) to assess the extent of potential contamination in soil especially along the eastern edge of this AOC, and

2) to evaluate whether compounds of concern from the Old Coke Plant are migrating through the groundwater to portions of the site not under hydraulic control by the operating groundwater extraction system.

Tasks

This section describes the tasks, procedures, decision points and rationale for investigating the impact to groundwater from the known contamination in AOC 2.

1) Install four monitoring wells (SOP-02 and SOP-05), RFIMW-4, RFIMW-5, RFIMW-15 and RFIMW-16, to the east of AOC 2 and between the Detroit River and AOC 2 (Figure 1-7). These monitoring wells will be installed as part of the site-wide groundwater investigation. The objective for placement of monitoring wells RFIMW-15 and RFIMW-16 is to locate the wells near the eastern edge of the area suspected

to be impacted by historical operation of the Old Coke Plant. If during installation of the monitoring wells, visible or olfactory evidence of soil contamination is detected, the boring will be relocated eastward. Criteria to relocate the boring include: obvious presence of tar, strong odor of ammonia, or FID organic vapor readings more than 20 ppmv above background. Borings will be relocated until a non-impacted boring (based on the prior criteria) location has been achieved. The monitoring well assembly will then be installed.

2) To estimate horizontal extent of Coke Plant wastes in soil, BASF will advance borings around the suspected perimeter of AOC 2. Assuming a perimeter of approximately 1,800 feet and depth of investigation of 10 feet, DNR guidance suggests that sample locations should be spaced 45 ft apart (DNR, April 1994). Since the objective of this investigation is to identify contamination instead of verify cleanup, the sample spacing will be increased from 45 ft to 100 ft. The exact number of locations and interval distances will vary if the AOC is larger than estimated in this work plan. Proposed locations are shown on Figure 1-11. Each boring will be sampled continuously (SOP-02) and samples of soil will be examined for visible and olfactory evidence of Coke Plant wastes. If evidence of contamination is found, the boring will be plugged, and a new boring will be advanced at a location 10 feet farther away from the source.

3) After the horizontal extent is found, select eight equally spaced borings from around the perimeters of AOC 2. One sample of soil will be obtained from each of the eight borings that define the perimeter and will be submitted for chemical analyses. Selection of the samples will be at the discretion of the field geologist and field manager taking into account the following criteria:

- Soil from the section appearing to be the most porous
- Soil from the section at a depth equivalent to contamination in other borings
- Soil from the section at the top of the water table
- Soil from the section from 1 to 2 ft below grade

4) Collect groundwater samples from RFIMW-15 and RFIMW-16 during a quarterly sampling round and submit to the analytical laboratory for analysis of polynuclear aromatic hydrocarbons, volatile aromatic compounds, phenolics, sulfide, cyanide, and metals (Table 1-3).

5) Measure the depth to groundwater (SOP-06) and calculate groundwater elevations in the four monitoring wells. Incorporate the groundwater elevation data with the rest of the site-wide groundwater elevation data to map and evaluate groundwater gradients in the vicinity of this AOC.

Data Usage

The soil analytical results will be used to define the extent of contamination for development of potential corrective measures at this AOC. The nature of potential contamination is known from the processes historically performed here. Additionally, analyses of wastes from AOC 4 will confirm the nature of contamination. The groundwater elevation data will be used to assess whether the groundwater from this AOC is being captured by the operating groundwater extraction system. Analytical results from analyses of groundwater will illustrate if the old Coke Plant area is contributing contaminates to the shallow groundwater.

1.5.12 AOC 3 - Old Concrete Carbose Skimmer Pit

Background

As described in Section 16.0 of the CCR, this concrete pit was designed and used as a wastewater flow-through process tank associated with carbose manufacturing. Wastewater treatment included oil separation, sedimentation, and neutralization. Carbose manufacturing at the Kreelon Plant was discontinued in the 1950s. Because the former Carbose Skimmer pit was classified as a wastewater treatment unit, it was exempt from both Federal and State underground storage tank regulations. There are no records of a release from this pit.

In 1992 and 1993, BASF excavated materials that had filled the former Carbose Skimmer Pit leaving the concrete structure intact. The materials filling the pit included soil, debris (including fire bricks), a black tarry substance, and water. All materials were transported to an appropriate off-site disposal facility. Piping entering the pit was plugged, and the pit was backfilled with clean sand and graded.

Conclusion

As described in the CCR, the concrete structure is still present but is filled with clean sand. The pit serves no useful purpose and is essentially a buried foundation. No further activities are planned for this AOC during the RFI.

1.5.13 AOC 4 - North Tar Pit

Background

As described in Section 17.0 of the CCR, the North Tar Pit area was used for disposal of the coal tar by-product from the Old Coke Plant. The placement of the tar was before 1966 based on facility records. The depth of the tar deposit is not known. The tar in this area has been covered with limestone fill but during the summer months, the material becomes fluid and buoyancy brings it to the surface. At these times the area is incapable of supporting vehicles or equipment.

Analytical data specific to this AOC has not been acquired. Two soil borings drilled during the TRIP are located on the eastern edge of this AOC. The borings encountered two to six feet of "black tar". Analysis of a sample of tar detected BTEX and styrene; however, other typical coal-tar constituents are likely present although they were not target parameters of the TRIP.

Objectives

The objective for an conducting an investigation at AOC 4 is to assess the nature and extent of the coal tar deposit to evaluate potential corrective measures.

Tasks

This section describes the tasks, procedures, decision points and rationale for investigating the nature and extent of the tar pit in AOC 4. Proposed sampling location are shown on Figure 1-11.

1) Collect two samples of tar using a hand operated auger (SOP-08). Two samples are assumed to be adequate to characterize the waste. Submit the samples for analyses of chemicals listed on Table 1-1 and physical characteristics that may aid in planning a corrective action. The analyses would follow ASTM protocols and may include strength tests, compaction tests, and density tests.

2) Conduct a geoelectrical resistivity survey (SOP-13) to assess the vertical extent of the tar pit and to provide an estimate of the horizontal extent. The geoelectrical method does not require heavy surface equipment that may sink into the tar. The survey technique is based on the inability of tar to conduct electricity as readily as the surrounding materials and the saturated zone.

3) Conduct a test boring program around the perimeter of the tar pit to confirm the lateral extent of the tar pit found during the resistivity survey. The test borings will be completed using a mobile hydraulic earth probe (SOP-09). Samples will be continuously collected from the surface to a depth of approximately 15 ft in each test boring and examined visually for the presence of tar. A depth of 15 ft was chosen because the deepest known occurrence of tar to date is 12 ft. The lateral extent of the tar pit will be assessed in test borings spaced 50 ft apart around the perimeter

of the tar pit. This spacing will yield sufficient data to define the lateral extent of the tar pit. Less than 6 inches of tar will be considered the edge of the tar pit.

4) If tar is found in a boring, the boring will be plugged and a new boring advanced 10 ft farther from the center. If tar is not found, a boring may be advanced closer to the center at the discretion of the field manager.

Data Usage

The data concerning the volume of the tar pit and the physical characteristics of the tar will be combined with an understanding of the chemical compounds of concern of coal tar to develop potential corrective measures for this AOC.

1.5.14 AOC 5 - PDC Spill Area

Background

In the early 1960s a salt bed cavity was developed at the North Works for the injection of PDC, a by-product of propylene oxide production at the South Works. The intent and design of the cavity was that the cavity would be competent, and the PDC could be recovered for possible sale or disposal. The injection well was plugged in the late 1970s.

PDC was transported to the well in railroad tank cars. Hoses were used to connect the car to the injection piping. Over the years, spillage occurred during unloading operations. BASF estimates total spillage in excess of 37,000 gallons of PDC, based on levels of residual material in the soils. Spreading of the spilled PDC in the groundwater and soil near the unloading pad caused contamination of the area now designated as AOC 5.

Infiltration of groundwater containing PDC from AOC 5 into the storm sewer system became a significant problem. Since 1990, the entire drainage system in the area has been reworked to utilize sewer pipe with welded joints to eliminate infiltration of impacted groundwater into

sewer pipe. The presence of PDC in the outfall has been reduced to conform to new lower NPDES permit levels.

Sampling and analyses of soils performed by BASF during 1985 mapped the distribution of PDC and found concentrations ranging into the thousands of parts per million. That study pre-dates the installation and operation of the groundwater extraction system. Nine groundwater extraction wells currently are in use at AOC 5. Three monitoring wells and two piezometers are used to monitor the effect of these extraction wells. A map of the water table based on second quarter 1994 data (Figure 1-12) indicates that the capture zone extends at least to wells P1NB and PM1NB. These are the two most easterly wells in this AOC. This investigation will focus on the area farther east and closer to the Detroit River than the previous study.

PDC is heavier than water and can sink through a porous medium. Data acquired by BASF (1985) show that PDC has accumulated at some low spots on top of the lacustrine clay layer. Several investigators have shown that the movement of PDC in a saturated medium is controlled by the configuration of the lower confining unit (U.S. EPA, 1992). That is, the lacustrine clay can act as a ramp, directing the PDC in a downslope direction.

Objective

The objectives of the investigation at AOC 5 are:

1) to evaluate the horizontal and vertical extent of VOCs and SVOCs in soils, because these groups of chemicals were associated with the spillage of PDC near the injection well,

2) to assess the lateral extent of VOCs and SVOCs in the groundwater on the eastern side of the AOC,

3) to map the water table and measure the radius of influence of the groundwater extraction wells

4) to evaluate the effectiveness of the groundwater extraction system at preventing migration of VOCs and SVOCs to the eastern boundary of the AOC and potentially off site to the Detroit River.

5) to investigate the orientation of the lower confining clay layer and identify preferred migration directions for PDC.

Tasks

This section describes the tasks, procedures, decision points and rationale for investigating potential contamination in soils and groundwater at AOC 5.

1) Five soil borings will be drilled for monitoring well installation. The five locations are identified as RFIMW-7, 8, 17, 18 and 21 on Figure 1-7. The rationale for these locations is described in Section 1.5.1. Drilling procedures and well construction procedures are described in SOP-02 and SOP-05.

2) Subsurface materials will be obtained and examined continuously from the land surface to the total depth of each boring, estimated to be approximately 25 ft. Sample descriptions will be recorded on the boring logs (SOP-02 and SOP-19).

3) Samples from borings RFIMW-7 and RFIMW-8, the eastern-most locations between the river and the AOC, will be collected. These wells were selected for soil sampling to supplement the analytical data collected by BASF in 1985. Samples will be collected in three-foot long segments (SOP-02) beginning at a depth of four-feet below the surface and extending to total depth of 3 ft into the lower clay unit (approximately 25 ft). Therefore, seven samples will be collected from each boring.

This sample spacing is consistent with that used by BASF during their 1985 investigation of AOC 5.

4) All borings in and around AOC-5 will be drilled three feet into the top of the lacustrine clay unit. Contour maps of the top of clay will be prepared to identify the direction that PDC may prefer to migrate. Borings drilled during the RFI will be supplemented with data from SSP&A (1984 and 1985) and BASF (1985).

5) Samples will be packaged, shipped to the laboratory (SOP-01), and analyzed for VOCs and SVOCs.

6) Samples of groundwater from the two perimeter monitoring wells, RFIMW-7 and RFIMW-8, will be collected (SOP-18) and analyzed for the compounds, listed at 40 CFR 264 Appendix IX (Table 7-4). Samples of groundwater from other wells at this AOC (RFIMW 18, 21 PM1NB and PM3NB) will be analyzed for VOCs and SVOCs. Well PM3NB is upgradient to this AOC.

7) Water levels in all wells within this AOC will be measured and recorded (SOP-06), converted to elevations and incorporated with site-wide groundwater elevation data. The elevations will be plotted on a site map, and a water table contour map will be prepared. This task will be completed as part of the site-wide groundwater investigation.

Data Usage

The groundwater elevation data and water table map will be used to assess the radius of influence of the groundwater extraction system. The radius of influence will be defined as the positions where groundwater flow gradients are equal to or less than 0.001 ft/ft toward the extraction wells. The soil analytical data will be used to assess the soil quality at the eastern side of the AOC. The groundwater analytical data will be used to evaluate the

effectiveness of the groundwater extraction system at preventing migration of compounds of concern to the eastern boundary of the AOC and potentially off site.

The physical and analytical data collected at this AOC are expected to indicate that either:

a) Contaminants are present at the river's edge and may be inside or outside the influence of the extraction system, but they potentially can migrate off site. This situation renders a corrective measure necessary.

b) Contaminants are not present at the river's edge and the extraction system is containing movement of chemicals.

c) PDC is present in the subsurface. The contaminant may not be influenced by the extraction system and may move making a corrective measure necessary.

1.5.15 AOC 6 - Tar Area (South End)

As discussed in Section 19.0 of the CCR, soils contaminated with coal tars were generated from an excavation dug to repair piping in the groundwater extraction system (between extraction wells E2NA and E3NA) in the southern portion of the North Works (Figure 1-4). Contaminated soils removed from the excavation were sampled and placed in roll-off boxes pending waste characterization. BASF personnel believe the origin of the coal tar was waste from the Coke Plant (AOC 2) that was used to fill in low spots.

In April 1992, the contaminated soil was sent off-site to Ross Incineration Services, Inc., Grafton, OH (EPA ID No. OHD 048415665) for incineration. Three shipments totaling 60 cubic yards were sent off-site bearing the EPA hazardous waste code D018 (benzene).

Objectives

The objective for conducting an investigation at AOC 6 is to define the horizontal and vertical extent of contaminants associated with the Tar Area so that an appropriate corrective action can be developed, if necessary.

Tasks

The following section describes the tasks, procedure, and decision points for characterizing the extent of contamination associated with the coal tar at AOC 6.

1) The position where the groundwater extraction system piping was repaired during 1992 will be identified from repair logs and the location will be staked.

2) A conductivity survey will be performed on a maximum 100-ft grid (SOP-13). This grid spacing is approximately one-quarter the size of the feature found on aerial photographs (see CCR Section 19.0). The spacing can be narrowed at the discretion of the field operator. As the edge of the AOC is identified, the positions well be staked (Figure 1-13).

3) Test borings will be positioned around the AOC to confirm the extent of coal tars. Each of the test borings will be advanced to a depth of approximately 10 ft., or until evidence of coal tar is not detected, using a mobile hydraulic rig (SOP-09). A target depth of 10 ft was chosen based on site topography, the depth to the water table and likely filling practices for waste material on site.

4) Each test boring will be sampled continuously (SOP-09), and soils will be screened with a FID or PID (SOP-11) to detect the presence of VOCs. If evidence of coal tar is found in a soil sample (either visual evidence or FID/PID readings over approximately 20 ppm above background), the boring will be abandoned and a new boring will be advanced at a location 10 ft farther away from the center. The

perimeter of the area found to contain coal tar will be delineated by borings spaced from 25 to 50 feet apart. This interval was selected based on the level of detail needed to develop potential corrective measures and on guidance published by the DNR (1994).

5) When field evidence indicates that the horizontal and vertical extent of the coal tar is found, the field manager will select eight equally spaced locations around the AOC and one sample of soil will be obtained from each boring. The samples will be packaged and shipped to the analytical laboratory (SOP-01). Selection of the one soil sample to be submitted for analysis will be at the discretion of the field geologist or field manager, but designed to satisfy as many of the selection criteria as possible:

- Soil exhibiting the highest reading on the FID/PID
- Soil from the unsaturated section appearing to be the most porous
- Soil from a depth equivalent to contamination in other borings
- Soil from unsaturated zone immediately above the water table
- Soil from the 1 to 2 ft interval

6) Soil samples will be analyzed for the typical constituents of concern found in coal tar (Table 1-3).

7) Analytical results will be compared to action levels and background.

Data Usage

If soil sample analytical results indicate that the extent of coal tar contamination has been found, then preliminary corrective action objectives will be developed consistent with Task V-C of the RFI Scope of Work. If results indicate that the extent of contamination has not been found, additional soil samples will be obtained and analyzed by following the procedures outlined in Tasks 2 through 5 above. Results will be documented in the RFI Report.

1.5.16 AOC 7 - Prussian Blue Area

Background

As described in Section 20.0 of the CCR, The Prussian Blue Area is at the northwest corner of the facility. From 1927 to 1937, the Detroit City Gas Company leased this area for a gas purification facility. They purchased coke oven gas from Michigan Alkali Company, purified it and sold it as heating, cooking, and lighting gas to local residents. Purification consisted of passing the gas through towers containing iron filings. These filings were converted to ferric ferrocyanide, called Prussian Blue, by the impurities in the coke oven gas. Traces of this waste material have been found in the North Works in this leased area. The gas purification operation was only conducted by the Detroit City Gas Company.

On February 18, 1994, the EPA visited the site to collect soil samples in the vicinity of AOC 7. BASF analyzed split samples obtained from the EPA. The EPA did not provide a plot illustrating the sample locations. In summary, concentrations of several metals and cyanide exceeded typical background levels published by the MDNR. Several PNA compounds also were present. BASF's analytical results are summarized on Table 20-1 of the CCR.

Objective

The objective of conducting an investigation at AOC 7 is to define the horizontal and vertical extent of contaminants associated with Prussian Blue so that an appropriate corrective action can be planned, if necessary.

Tasks

The following section describes the tasks, procedures, and decision points for characterizing the nature and extent of contaminants associated with Prussian Blue in the vicinity of AOC 7.

1) Two perimeter groundwater monitoring wells are proposed in the vicinity of AOC7. Monitoring well RFIMW-24 is a proposed background location. Monitoring well RFIMW-23 will be downgradient from AOC 7. Groundwater from both of these wells is scheduled to be analyzed for all compounds listed at 40 CFR 264 Appendix IX (see Section 1.5.1). Results from the two wells will be compared to each other to estimate if AOC 7 is contributing contaminants to groundwater.

2) BASF will survey the locations where EPA collected soil samples in February 1994 (Figure 1-14).

   Since all samples contained at least one analyte above default background concentrations, EPA samples can be used to define nature of contamination, but they are not useful for defining extent.

3) To estimate vertical extent, BASF will use a drill rig to acquire continuous samples of soil from one boring (see SOP-09) advanced near location BASF 3A where EPA found the highest concentrations of chemicals in soil. The soil will be examined for visible evidence of contamination (i.e., the distinctive blue color). Drilling will continue to a depth of 15 ft below grade or at least 5 ft below any visible evidence of contamination, whichever is deeper.

   This boring will identify the maximum depth of contamination at the source. Each one-foot long segment of soil will be submitted to the laboratory. All samples will be analyzed for cyanide (due to short holding time). Samples will be chosen for analyses of metals in the following order. The first sample analyzed will be from the last one-foot segment to contain evidence of Prussian Blue. The second sample analyzed will be from the soil segment immediately below the last visible evidence of Prussian Blue. The third sample will be from the soil segment 3 feet below the second sample. If the two soil samples that did not exhibit evidence of Prussian Blue do not contain metals or cyanide above action levels, then the remaining samples will not be analyzed. If either sample contains RCRA metals or cyanide above action

levels, then the Data Manager will instruct the laboratory to analyze additional samples. Sample selection will aim at finding the vertical extent of contamination by analyzing the fewest number of samples.

4) To estimate horizontal extent, BASF will use a cable trenching tool (a Ditch-Witch) and advance borings around the area sampled by EPA. At this time, BASF personnel do not know the horizontal extent of this AOC. The Ditch-Witch will be used to examine soils to a depth of approximately 3 ft along the edges of parking lots, sidewalks, and driveways in order to screen for the distinctive color of Prussian Blue in soils. The area to be investigated is shown on Figure 1-14. Soil borings will be advanced to "fill in" spaces where trenching is not feasible. The selection of sampling locations will be at the discretion of the field manger. Probing with borings and the Ditch-Witch will continue until the perimeter of this AOC is found with a certainty of plus or minus 25 ft.

5) After the horizontal extent is found, one sample of soil will be obtained from each of eight equally spaced borings that define the perimeter of AOC 7. Samples will be submitted for chemical analyses. Selection of the samples will be at the discretion of the field geologist taking into account the following criteria:

- Soil from the section appearing to be the most porous
- Soil from the section at a depth equivalent to contamination in other borings
- Soil from the section at the top of the water table
- Soil from the section from 1 to 2 ft below grade

6) Soil samples collected during Tasks 3 and 5 will be analyzed for the eight RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver) and total cyanide (see Table 7-2 for the list of methods).

7) Concentrations reported by the laboratory will be compared to background concentrations (both local and default values), DNR's 20-times GSI values, or DNR's

direct contact values, as appropriate. Michigan's Act 307 cleanup criteria provide guidance for selecting the most appropriate value (see Appendix A). In general, metals and cyanide will be compared to background.

Data Usage

If analytical results indicate that the extent of contamination had been identified, preliminary corrective action objectives will be developed consistent with Task V-C of the RFI Scope of Work (U.S. EPA, 1994). Results will be documented in the RFI report. If analytical results indicate that the vertical or horizontal extent of contamination had not been identified, additional samples will be obtained, analyzed and compared to action levels by following tasks 3 through 7 explained above.

1.5.17 AOC 8 - Styrene Spill Area

Background

As described in Section 21.0 of the CCR, this area is contained within AOC 1. In August 1975, an estimated 15,000 gallons of styrene were released to the soil over a period of several weeks. Styrene leaked through an imperfect weld at the bottom of a new above-ground storage tank. The spilled material, which is lighter than water, migrated to groundwater where it floated on the water table and collected in a nearby electrical manhole. Recovery efforts initiated immediately after the spill was discovered recovered approximately 52 percent of the spilled styrene. During a two-year period after the spill, styrene and groundwater were removed from various locations in the electrical manhole system. Periodic pumping of styrene and water from electrical manholes is continuing.

Conclusion

The location of the styrene spill is within the area designated as AOC 1 and within the area being addressed by the TRIP (styrene is one of the target parameters). Results from that

project as they relate to the styrene spill area will be included in the RFI report. Manholes where water containing styrene is encountered will continue to be pumped out as they are encountered. Therefore, no additional activities are planned for AOC 8 during the RFI.

1.5.18 AOC 9 - Propylene Oxide Spill Area

Background

As described in Section 22.0 of the CCR, an estimated 46,000 gallons of propylene oxide was released to the soil during August 1987. The spill was caused by external corrosion of an underground transfer line. When the release was discovered the fire water deluge system was activated in conjunction with additional fire fighting equipment to minimize the explosion hazard from vapors. More than three million gallons of water was applied to the spill area over a period of two days. Surface water and groundwater containing dissolved propylene oxide was recovered using a system of pits and extraction wells. Operation of the temporary groundwater extraction system resulted in development of a cone of depression that effectively prevented the migration of propylene oxide in the groundwater. The groundwater extraction system was operated and monitored until the concentrations of dissolved propylene oxide and propylene glycol (the degradation product) were below their regulatory action levels.

Propylene oxide is miscible with water and it reacts with water to form propylene glycol. This reaction is catalyzed by caustic substances such as the alkaline soils at this facility. Propylene oxide and its degradation products are easily biodegradable by naturally occurring soil bacteria, and propylene glycol degrades to ketones and aldehydes and eventually into organic acids.

Conclusion

No further investigatory activities are planned for AOC 9 during the RFI because at the present time, neither the spilled material nor its degradation products are listed as hazardous

waste or as hazardous waste constituents. However, as part of the site-wide groundwater investigation, propylene glycol and propylene oxide will be included as target analytical parameter for the initial groundwater sampling event for monitoring wells RFIMW-2, RFIMW-14, TMW-1 and TMW-2.

1.5.19 Trenton Channel Sediments

Background

Historical information indicates that groundwater, surface water runoff and effluent left the North Works and entered the Trenton Channel. During the last eight to ten years, BASF has reduced the volume of groundwater and surface water runoff leaving the North Works by:

- Installation and operation of a groundwater extraction system
- Installation of steel sheet piling along the dock at the river's edge
- Installation of sealed sewer pipes to reduce contaminated groundwater from entering the effluent stream.

Evaluating the effectiveness of the current groundwater extraction system to prevent contaminants from entering the Trenton Channel from the North Works is an objective of this RFI (see Section 1.1.1).

In correspondence dated January 25, 1995, EPA required BASF to include tasks within this QAPP to investigate and to assess sediment quality in the Trenton Channel adjacent to the North Works.

BASF readily agrees with EPA that sediment quality has been impacted adversely during over 100 years of discharges from a variety of sources to the River and its tributaries. Numerous reports prepared by EPA, the Michigan DNR, the Army Corp of Engineers, and Canadian environmental groups are available that document the distribution of contaminants

in Detroit River sediments. The availability of data immediately adjacent to the BASF facility (i.e., within tens or hundreds of feet) has yet to be determined. Although a large amount of analytical data is available for the Detroit River, the analytes typically are limited to metals, PCBs, oil and grease, PNAs, cyanide, and suspended solids.

Objectives

The objectives for assembling information already available on sediments in the Trenton Channel are to:

- Catalog physical and chemical characteristics of the sediment adjacent to the North Works
- Identify critical habitats (if any) near the North Works
- Catalog potential sources of chemicals to the River
- Identify potential discharges from the North Works to the River
- Identify frequency, deposition, and consequences of dredging
- Identify DQOs and recommend reasonable locations to sample sediments if significant data gaps are identified

The outcome from fulfilling these objectives will be a report that:

- Defines "control zones" up and downstream from North Works
- Defines the sediment quality adjacent to the North Works and compares it to the control zones
- Identifies potential contributions from the North Works
- Recommends additional investigations as necessary
- Recommends a corrective measure study if contaminants are leaving the facility.

Tasks

The volume of data available on the Detroit River is extensive. In order to limit the examination to a manageable amount of information, the investigation will focus on the Trenton Channel near the North Works. The Trenton Channel is that portion of the Detroit River from Mud Island on the north to Elizabeth Park on the south and between Grosse Ile and the Michigan shore.

1) Assemble available reports that contain analytical data on the quality of water and sediments in the Trenton Channel. All data from EPA reports are assumed to be completely valid (Analytical Level IV).

2) Assemble available reports that describe the habitats, substrate, biota, and flow characteristics of the Trenton Channel. Information from large compendia such as the UGLCCS, Detroit River RAP, and ARCS program will be the primary sources of information.

3) Prepare maps and/or diagrams based on existing data that illustrate the Trenton Channel system. These drawings will include:

- Habitats, dredged areas, spoils piles
- Sediment distribution, thickness, depositional areas and scour areas
- Locations of point sources of chemicals to the River
- Illustrate groundwater discharge potential prior to installing the extraction system
- Map distribution and concentration of selected contaminants in sediments. Availability of data will influence selection of chemicals; however, mercury, lead and VOCs will be among the chemicals selected.

4) Compile the data and information into a report. The report will be either a section of the RFI report a stand-alone assessment report.

5) The report will describe the habitats (receptors) adjacent to the North Works; the distribution of contaminants in sediment that are at the North Works, water quality and flow distribution (pathways); the dischargers (sources) and chemicals being discharged, and an estimation of adverse impacts or impairments (risk assessment).

Data Uses

If data are adequate to document nature and distribution of contamination, BASF will recommend no further action in the Trenton Channel. If data are inadequate to formulate conclusions on sediment quality near the North Works, a sediment sampling plan will be prepared for EPAs review and approval.

If data indicate that contaminants are entering the Trenton Channel from the North Works, BASF will examine feasible remedies in a Corrective Measures Study.

As stated earlier, the quality of sediments and water in the Detroit River has been impacted by over 100 years of discharges. The need to acquire additional analytical data to confirm this fact is not necessary.

BASF is an active participant in the RAP process and the BPAC as described in the Public Participation Plan. BASF intends to continue working with these groups.

1.5.20 Sample Summary Table

The sample summary table is presented on Table 1-1.

1.6 PROJECT SCHEDULE

BASF anticipate that field work will begin approximately 90 days after EPA approves the RFI Work Plan. Figure 1-15 presents the schedule anticipated for the RFI. The duration of the RFI is estimated at 13 months.

TABLE 1-1
SUMMARY TABLE OF THE SAMPLING AND ANALYSIS PROGRAM FOR RCRA FACILITY INVESTIGATION
BASF CORPORATION, WYANDOTTE, MICHIGAN

Location	Matrix	Field Parameters[1]	Laboratory Parameters	Analytical Method[9]	Investigative Samples			Field Quality Control Samples						Rinsate Blanks[3]			Blind Duplicates			MS/MSD[4]			Total Samples
								Field Duplicates[2]			Trip Blanks												
					No.	Freq.	Total	No.	Freq.[10]	Total	No.[5]	Freq.	Total	No.	Freq.[10]	Total	No.	Freq.[10]	Total	No.	Freq.[10]	Total	
Fifteen Perimeter Monitoring Wells RFIMW-1 -> RFIMW-12 RFIMW-22, RFIMW-23 PM1NA	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	Volatile Organics, Semivolatile Org., PCBs/Pesticides, Herbicides, Dissolved & Total Metals, Cyanide Sulfide	SW-846-8260 SW-846-8270A SW-846-8080 SW-846-8150A (7, 8) SW-846-9012A SW-846-9030A	15 15 15 15 15 15 15	4 4 4 4 4 4 4	60 60 60 60 60 60 60	1 1 1 1 1 1 1	1/10 1/10 1/10 1/10 1/10 1/10 1/10	8 8 8 8 8 8 8	2 NA NA NA NA NA NA	4 NA NA NA NA NA NA	8 0 0 0 0 0 0	2 2 2 2 2 2 2	4 4 4 4 4 4 4	8 8 8 8 8 8 8	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	4 4 4 4 4 4 4	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	4 4 4 4 4 4 4	**92** **84** **84** **84** **84** **84** **84**
Seven Background Wells RFIMW-24 -> RFIMW-28 P34N, P35N	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	Volatile Organics, Semivolatile Org., PCBs/Pesticides, Herbicides, Dissolved & Total Metals, Cyanide Sulfide	SW-846-8260 SW-846-8270A SW-846-8080 SW-846-8150A (7, 8) SW-846-9012A SW-846-9030A	7 7 7 7 7 7 7	6 6 6 6 6 6 6	42 42 42 42 42 42 42	1 1 1 1 1 1 1	1/10 1/10 1/10 1/10 1/10 1/10 1/10	6 6 6 6 6 6 6	2 NA NA NA NA NA NA	6 NA NA NA NA NA NA	12 0 0 0 0 0 0	2 2 2 2 2 2 2	6 6 6 6 6 6 6	12 12 12 12 12 12 12	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	6 6 6 6 6 6 6	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	6 6 6 6 6 6 6	**84** **72** **72** **72** **72** **72** **72**
SWMU E[11] RFIPZ-1 -> RFIPZ-4 RFIMW-13	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	Volatile Organics, Semivolatile Org., PCBs/Pesticides, Herbicides, Dissolved & Total Metals, Cyanide Sulfide	SW-846-8260 SW-846-8270A SW-846-8080 SW-846-8150A (7) SW-846-9012A SW-846-9030A	5 5 5 5 5 5 5	1 1 1 1 1 1 1	5 5 5 5 5 5 5	1 1 1 1 1 1 1	1/10 1/10 1/10 1/10 1/10 1/10 1/10	1 1 1 1 1 1 1	1 NA NA NA NA NA NA	1 NA NA NA NA NA NA	1 0 0 0 0 0 0	1 1 1 1 1 1 1	1 1 1 1 1 1 1	1 1 1 1 1 1 1	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	0 0 0 0 0 0 0	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	1 1 1 1 1 1 1	**9** **8** **8** **8** **8** **8** **8**
AOC-2 RFIMW-15 RFIMW-16	Groundwater	pH, Redox,Specfic Conductance, Temperature, Dissolved Oxygen, Water Level	Volatile Organics, Semivolatile Org. Dissolved & Total Metals, Cyanide Sulfide	SW-846-8260 SW-846-8270A (7) SW-846-9012A SW-846-9030A	2 2 2 2 2	1 1 1 1 1	2 2 2 2 2	1 1 1 1 1	1/10 1/10 1/10 1/10 1/10	1 1 1 1 1	1 NA NA NA NA	1 NA NA NA NA	1 0 0 0 0	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	1/20 1/20 1/20 1/20 1/20	1 1 1 1 1	1 1 1 1 1	1/20 1/20 1/20 1/20 1/20	1 1 1 1 1	**7** **6** **6** **6** **6**
AOC-5 RFIMW-18, RFIMW-21 PM1NB PM3NB	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	Volatile Organics Semivolatile Org.	SW-846-8260 SW-846-8270A	4 4	1 1	4 4	1 1	1/10 1/10	2 2	1 NA	1 NA	1 0	1 1	1 1	1 1	1 1	1/20 1/20	1 1	1 1	1/20 1/20	1 1	**10** **9**
AOC-9 RFIMW-2[12], RFIMW-14 TMW-1, TMW-2	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	Propylene Glycol Propylene Oxide	SW-846-8015 SW-846-8015	4 4	1 1	4 4	1 1	1/10 1/10	1 1	NA NA	NA NA	0 0	1 1	1 1	1 1	NA NA	NA NA	0 0	1 1	1/20 1/20	1 1	**7** **7**
All Other Wells E1 -> E15, TMW-3 -> TMW-5 RFIMW-13,17, 19, 20, 21 PM2NA, PM3NA, PM2NB PM1NC, PM2NC, P1NA P2NA, P1NB, P2NB, P3NB P1NC, P2NC	Groundwater	pH, Redox ,Specific Conductance, Temperature, Dissolved Oxygen, Water Level	None	None	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**0**
Background Monitoring Wells RFIMW-24 -> RFIMW-28	Soil	PID or FID	Volatile Organics Semivolatile Org. Metals Cyanide Pesticids/PCBs Herbicides Sulfide	SW-846-8240A SW-846-8270A (7) SW-846-9012A SW-846-8080 SW-846-8150A SW-846-9030A	10 10 10 10 10 10 10	1 1 1 1 1 1 1	10 10 10 10 10 10 10	1 1 1 1 1 1 1	1/10 1/10 1/10 1/10 1/10 1/10 1/10	1 1 1 1 1 1 1	1 NA NA NA NA NA NA	1 NA NA NA NA NA NA	1 0 0 0 0 0 0	2 2 2 2 2 2 2	1 1 1 1 1 1 1	2 2 2 2 2 2 2	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	0 0 0 0 0 0 0	1 1 1 1 1 1 1	1/20 1/20 1/20 1/20 1/20 1/20 1/20	1 1 1 1 1 1 1	**15** **14** **14** **14** **14** **14** **14**
SWMU E	Sediment	PID or FID pH	TCLP Extraction - Volatile Organics - Semivolatile Organics - Metals - Pesticides - Herbicides - Ignitability	SW-846-1311 SW-846-8240A SW-846-8270A (7) SW-846-8080 SW-846-8150A ASTM D93-80	2 2 2 2 2 2 2	1 1 1 1 1 1 1	2 2 2 2 2 2 2	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	0 0 0 0 0 0 0	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	0 0 0 0 0 0 0	1 1 1 1 1 1 1	1 1 1 1 1 1 1	1 1 1 1 1 1 1	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	0 0 0 0 0 0 0	NA 1 1 1 1 1 NA	NA 1/20 1/20 1/20 1/20 1/20 NA	0 1 1 1 1 1 0	**3** **4** **4** **4** **4** **4** **3**

TABLE 1-1
SUMMARY TABLE OF THE SAMPLING AND ANALYSIS PROGRAM FOR RCRA FACILITY INVESTIGATION
BASF CORPORATION, WYANDOTTE, MICHIGAN

Location	Matrix	Field Parameters[1]	Laboratory Parameters	Analytical Method[9]	Investigative Samples			Field Quality Control Samples						Rinsate Blanks[3]			Blind Duplicates			MS/MSD[4]			Total Samples
								Field Duplicates[2]			Trip Blanks												
					No.	Freq.	Total	No.	Freq.[10]	Total	No.[5]	Freq.	Total	No.	Freq.[10]	Total	No.	Freq.[10]	Total	No.	Freq.[10]	Total	
SWMU F	Soil	PID or FID	Spontaneous Comb.	49CFR 173 APPX. E	10	1	10	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**10**
			Ignitability	ASTM D93-80	10	1	10	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**10**
			TCLP Extraction	SW-846-1311	10	1	10	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**10**
			- Volatile Organics	SW-846-8240A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Semivolatile Organics	SW-846-8270A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Metals	(7)	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Pesticides	SW-846-8080	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Herbicides	SW-846-8150A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
SWMU G	Soil	PID or FID	TCLP Extraction	SW-846-1311	10	1	10	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**10**
			- Volatile Organics	SW-846-8240A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Semivolatile Organics	SW-846-8270A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Metals	(7)	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Pesticides	SW-846-8080	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
			- Herbicides	SW-846-8150A	10	1	10	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**12**
SWMU H	Soil	PID or FID	Volatile Organics	SW-846-8240A	10	1	10	1	1/10	1	1	1	1	2	1	2	NA	NA	0	1	1/20	1	**15**
			Semivolatile Org.	SW-846-8270A	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
			Metals	(7)	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
			Cyanide	SW-846-9012A	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
			Pesticides/PCBs	SW-846-8080	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
			Herbicides	SW-846-8150A	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
			Sulfide	SW-846-9030A	10	1	10	1	1/10	1	NA	NA	0	2	1	2	NA	NA	0	1	1/20	1	**14**
AOC 2[14]	Soil	PID or FID	Volatile Organics	SW-846-8240A	8	1	8	1	1/10	1	1	1	1	1	1	1	NA	NA	0	1	1/20	1	**12**
			Semivolatile Organics	SW-846-8270A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Metals	(7)	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Cyanide	SW-846-9012A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Sulfide	SW-846-9030A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
AOC 4[14]	Soil/Tar	PID or FID	Volatile Organics	SW-846-8240A	2	1	2	1	1/10	1	1	1	1	1	1	1	NA	NA	0	1	1/20	1	**6**
			Semivolatile Organics	SW-846-8270A	2	1	2	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**5**
			Metals	(7)	2	1	2	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**5**
			Cyanide	SW-846-9012A	2	1	2	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**5**
			Moisture Content	ASTM D2216	2	1	2	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**2**
			Compaction	ASTM D558	2	1	2	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**2**
			Strength	ASTM D2166	2	1	2	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**2**
			BTU Value	ASTM D240	2	1	2	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	NA	NA	0	**2**
			Sulfide	SW-846-9030A	2	1	2	NA	NA	0	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**4**
AOC 5 RFIMW-7, RFIMW-8	Soil	PID or FID	Volatile Organics	SW-846-8240A	14	1	14	1	1/10	2	1	1	1	1	1	1	NA	NA	0	1	1/20	1	**19**
			Semivolatile Organics	SW-846-8270A	14	1	14	1	1/10	2	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**18**
AOC 6[14]	Soil	PID or FID	Volatile Organics	SW-846-8240A	8	1	8	1	1/10	1	1	1	1	1	1	1	NA	NA	0	1	1/20	1	**12**
			Semivolatile Organics	SW-846-8270A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Metals	(7)	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Cyanide	SW-846-9012A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
			Sulfide	SW-846-9030A	8	1	8	1	1/10	1	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**11**
AOC 7	Soil		Metals	(13)	11	1	11	1	1/10	2	NA	NA	0	1	1	1	NA	NA	0	1	1/20	1	**15**
			Cyanide	SW-846-9012A	23	1	23	1	1/10	3	NA	NA	0	1	1	1	NA	NA	0	1	1/20	2	**29**
SWMU E RFIMW-13 RFIPZ-1 -> RFIPZ-4	Groundwater	Water Levels	None	None	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 1-1
SUMMARY TABLE OF THE SAMPLING AND ANALYSIS PROGRAM FOR RCRA FACILITY INVESTIGATION
BASF CORPORATION, WYANDOTTE, MICHIGAN

Notes:

1	The field parameters pH, temperature, specific conductance, dissolved oxygen and Redox potential will be measured in the field at the time of sample collection.
2	One field duplicate to be collected per ten investigative samples.
3	Rinsate blank samples will be collected at a frequency of one per day that decontamination occurs. The numbers in Table 1-1 are estimates.
4	Samples designated for matrix spike/matrix spike duplicate (MS/MSD) will be collected at a frequency of one set per group of 20 or fewer investigative samples. Three independent samples (i.e., triple the normal sample volumes) will be collected for VOC analysis to avoid splitting samples. MS samples only will be collected for TCLP analyses.
5	One VOA trip blank sample will be provided and analyzed by the laboratory per cooler that contains samples for VOC analysis. The numbers in Table 1-1 are estimates.
6	Groundwater samples to be analyzed for dissolved metals will be filtered in the field with a 0.45 micron filter.
7	See QAPP Table 7-2 for analytical methods for metals.
8	Groundwater samples will be analyzed for total and dissolved metals during the first quarterly sampling round only. Subsequent sampling and analysis will be for dissolved metals only.
9	Laboratory methods are listed in QAPP Table 7-2.
10	Frequency of QA/QC samples as indicated, or one per sampling round, whichever is greater.
11	This sampling and analysis program will be conducted only if groundwater mounding is detected in this SWMU. Sampling will occur at next quarterly sampling round.
12	This well is also included in the Perimeter Well list for sampling and analysis.
13	Analyses only for the eight RCRA metals will be performed (See Table 1-4).
14	See Table 1-3 for list of parameters.
NA	Not Applicable. Quality control samples will not be collected for these types of analyses.
Redox	Oxidation - Reduction Potential

TABLE 1-2

MAXIMUM CONCENTRATION OF CONTAMINATIONS FOR THE TOXICITY CHARACTERISTIC

EPA HW No.[1]	CONTAMINANT	CAS No.[2]	REGULATORY LEVEL (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-2	0.5
D006	Cadmium	7440-43-9	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlorodane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	[4]200.0
D024	m-Cresol	108-39-4	[4]200.0
D025	p-Cresol	106-44-5	[4]200.0
D026	Cresol		[4]200.0
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	[3]0.13
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	[3]0.13
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0

EPA HW No.[1]	CONTAMINANT	CAS No.[2]	REGULATORY LEVEL (mg/L)
D036	Nitrobenzene	98-95-3	2.0
D037	Pentrachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	[3]5.0
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

1 Hazardous waste number.

2 Chemical abstracts service number.

3 Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.

4 If o-, m- and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/l.

TABLE 1-3

TYPICAL COAL TAR CHEMICAL CONSTITUENTS

INORGANICS	METALS	VOLATILE AROMATICS	PHENOLICS	POLYNUCLEAR AROMATIC HYDROCARBONS
Ammonia [1]	Aluminum [1]	Benzene	Phenol	Acenaphthene
Cyanide	Antimony	Ethylbenzene	2-Methylphenol	Acenaphthylene
Nitrate [1]	Arsenic	Toluene	4-Methylphenol	Anthracene
Sulfate [1]	Barium	Total Xylenes	2,4,-Dimethylphenol	Benzo(a)anthracene
Sulfide	Cadmium			Benzo(a)pyrene
Thiocyanate [1]	Chromium			Benzo(b)fluoranthene
	Copper			Benzo(g,h,i)perylene
	Iron [1]			Benzo(k)fluoranthene
	Lead			Chrysene
	Manganese [1]			Dibenzo(a,h)anthracene
	Mercury			Dibenzofuran
	Nickel			Fluoranthene
	Selenium			Fluorene
	Silver			Naphthalene
	Vanadium			Phenanthrene
	Zinc			Pyrene
				2-Methylnaphthalene
				Indeno(1,2,3-cd)pyrene

(1) These parameters are not listed at 40 CFR 264 Appendix IX, and samples will not be analyzed for these parameters.

TABLE 1-4

CHEMICALS FOR INVESTIGATION AT PRUSSIAN BLUE AREA (AOC 7), BASF CORPORATION WYANDOTTE, MICHIGAN

ARSENIC

BARIUM

CADMIUM

CHROMIUM

LEAD

MERCURY

SELENIUM

SILVER

CYANIDE

RCRA FACILITY INVESTIGATION PRE-INVESTIGATION EVALUATION OF CORRECTIVE MEASURES BASF CORPORATION WYANDOTTE, MICHIGAN

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BASF Corporation - RFI
USEPA Docket No. V-W-011-94
Corrective Measures Technologies Evaluation

TABLE OF CONTENTS

BASF Corporation - RFI
USEPA Docket No. V-W-011-94
Corrective Measures Technologies Evaluation

PRE-INVESTIGATION EVALUATION OF CORRECTIVE MEASURES TECHNOLOGIES BASF CORPORATION NORTH WORKS WYANDOTTE, MICHIGAN

1.0 INTRODUCTION

A pre-investigation screening of corrective measures technologies has been conducted to identify potential technologies that may be implemented on-site or off-site for the containment, treatment, remediation, and/or disposal of contamination from the Facility. This report has been prepared to meet the requirements of the RCRA Facility Investigation (RFI) Scope of Work included as Attachment II to the Administrative Order on Consent (EPA ID No: MID 064 197 742), February 28, 1994.

This pre-investigation evaluation identifies general corrective actions, and presents an initial screening of technologies and process options that are expected to meet the preliminary corrective measures objectives. This evaluation is based on currently available data for the site as presented in the Current Conditions Report. The corrective measures objectives will be developed following completion of the facility investigation. This pre-investigation evaluation also identifies field data that needs to be collected in the RFI that may provide information to facilitate the evaluation and selection of the final corrective measures.

2.0 IDENTIFICATION OF CORRECTIVE MEASURES TECHNOLOGIES

2.1 General Corrective Actions

This pre-investigation evaluation consists of development of general corrective actions, followed by identification and preliminary screening of corrective measures technologies. The general corrective actions are broad classes of actions or remedies that are expected to satisfy the corrective action goals. The corrective action goals will be developed after

completion of the facility investigation. The following general corrective actions have been identified for the site.

- No Action, which consists of leaving the site "as is," with no provisions being made for monitoring, control, or clean-up of the contamination.

- Containment, which involves physical restrictions on contaminant mobility and water infiltration.

- Extraction or Removal, which involves the direct physical removal of the contaminated media or contaminant sources.

- Treatment, which involves on-site and/or off-site measures to reduce toxicity, mobility, or volume of the contaminated materials.

- Discharge or Disposal, which involves measures to relocate contaminants in such a way as to reduce their interaction with the public and the environment.

2.2 Identification of Technologies and Process Options

A master list of potentially applicable treatment technologies and process options within each technology was prepared. The term "corrective measures technology" refers to general categories of technology types, such as biological treatment, chemical treatment, and thermal destruction. The term "process option" refers to specific processes within each technology category. For example, under the technology category of biological treatment, there may be aerobic and anaerobic treatment process options. The technologies and process options considered applicable to the site were assembled after review of the following:

- USEPA guidance documents and directives
- Pertinent textbooks, technical journals and seminar/conference proceedings
- Information provided by remediation contractors

- WCC's past experience in hazardous waste remediation

Some of the key documents used in this review were:

- Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites (USEPA, 1988d)
- *Standard Handbook of Hazardous Waste Treatment and Disposal* (Freeman, 1989)
- Basics of Pump-and-Treat Groundwater Remediation Technology (USEPA, 1990)
- Superfund Innovative Technology Evaluation Program, Sixth Edition (USEPA, 1993)
- Remediation of Contaminated Sediments (USEPA, 1991)

Table 1 lists the potential treatment technologies and corresponding process options. The technologies and process options listed in these tables were selected based on the fate and transport characteristics of the chemicals of concern identified in groundwater and soil at the site and on the applicability of a given technology or process option to these media.

2.3 Initial Screening of Technologies and Process Options

The corrective measures technologies and process options for groundwater and soil identified in Table 1 were screened on the basis of technical implementability. Screening based on technical implementability identifies technologies that will potentially address the chemical and hydrogeological characteristics of the site. This screening does not utilize other criteria for selection such as effectiveness or cost.

Table 2 describes the process options, presents initial screening comments, and summarizes the technology screening process for the process options. A description of each process option is included in the table to provide an understanding of each option and to assist in the evaluation of its technical implementability. The screening comments address the

technical feasibility and the ability of a given process option to serve its intended purpose. The screening comments include a statement as to whether each process option was determined to be potentially applicable or was rejected.

3.0 FIELD DATA NEEDS

This pre-investigation evaluation has identified corrective measures technologies that will likely be included for additional consideration in the Corrective Measures Study to be completed after the RFI. Field data will be collected during the RFI that will provide information on the applicability of these technologies for remediation of contaminated media at the site. Field data that will be collected during the RFI may include analytical data to characterize the extent of soil and groundwater contamination.

The specific sampling procedures and sampling locations are presented in the RFI Work Plan.

TABLE 1
SUMMARY OF POTENTIAL CORRECTIVE MEASURES TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER, SOIL, AND SEDIMENT BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTION	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTION
No Action	None	None
Groundwater Containment	Capping	Clay/Soil, Multimedia, Asphalt, Concrete
	Drainage Controls	Storm Drains, Grading
	Vertical Hydraulic Barriers	Slurry Wall, Grout Curtain, Sheet Piling
	Hydraulic Barriers/Gradient Control	Extraction Wells, Injection Wells, Interceptor Trenches
Sediment Containment	Capping	Level bottom capping, contained aquatic disposal
Soil Removal	Mechanical Excavation/Backfill	Backhoe
Sediment Removal	Dredging	Mechanical, hydraulic, or pneumatic dredge
Groundwater Collection	Extraction	Extraction Wells, Extraction/Injection Wells
	Subsurface Drains	Interceptor Trenches
Sediment Pretreatment	Biological	Nutrient or microorganism injection
	Chemical	Chemical Conditioning
	Physical	Particle Classification/Separation
Treatment	Biological	Aerobic or Anaerobic bioreactors, composting, land treatment
	Chemical	Stabilization/Solidification, Dehalogenation
	Physical	Solvent extraction, Adsorption, Membrane Separation, Photolytic Oxidation, Air/Steam Stripping
	Thermal	Incineration, Low Temperature Thermal Stripping, Super-Critical Water Oxidation, Wet Oxidation, Pyrolysis
	Off-Site	POTW, RCRA Facility

TABLE 1 (Continued)
SUMMARY OF POTENTIAL CORRECTIVE MEASURES TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER, SOIL, AND SEDIMENT
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTION	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTION
	In-Situ	Bioremediation, Air Sparging/Bioventing, Vitrification, Stabilization/Solidification, Vapor Extraction, Dual-Phase Extraction, Metal Enhanced Abiotic Degradation
Discharge of Groundwater	On-Site	Deep Well Injection, Outfalls
	Off-Site	POTW
Disposal of Soil/Sediment	On-Site	Lined and capped cell
	Off-Site	RCRA facility

TABLE 2
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
No Action	None	None	No Action	PA	Regulatory requirement.
Groundwater Containment	Capping (to minimize infiltration and surface exposure)	Clay/Soil	Compacted clay covered with soil over contaminated areas.	PA	
		Multimedia	Compacted clay and a synthetic membrane covered by soil over areas of contamination.	PA	
		Asphalt	Application of layer of asphalt over area of contamination.	PA	Not commonly used for large areas.
		Concrete	Installation of concrete slab over area of contamination.	PA	Not commonly used for large areas.
	Drainage Controls	Storm Drains	Divert building roof drains and subsurface drains from areas of contamination to minimize infiltration.	PA	
		Grading	Regrade contaminated areas to minimize infiltration of surface water into soil, and migration of contaminants.	PA	
	Vertical Hydraulic Barriers	Slurry Wall	Trench surrounding area of contamination is filled with a soil (or cement)-bentonite slurry.	PA	
		Grout Curtain	Pressure injection of cement grout in a circumferential pattern of drilled holes.	NA	Likelihood for gaps in the barriers which may decrease effectiveness.
		Sheet Piling	Drive steel sheet piling into earth to contain groundwater.	NA	Not an effective long-term technology.

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Groundwater Containment (Continued)	Hydraulic Barriers/Gradient Control (Continued)	Extraction Wells	Extract groundwater at a rate high enough to change groundwater gradient, thus creating a hydraulic barrier to contaminant migration. May be used in combination with reinjection wells.	PA	Currently in use at site.
		Injection Wells	Inject uncontaminated water into aquifer in order to alter groundwater flow direction and create a barrier to contaminated groundwater flow.	PA	
		Interceptor Trench	Trench backfilled with gravel would be used to control the groundwater flow through contaminant source areas.	PA	
Sediment Containment	Capping	Level bottom capping	Place contaminated sediments on the bottom of waterway in a discrete mound and cover with a cap of clean sediment.	PA	Potentially applicable for on-site lagoons, not applicable in river, because currents would likely erode and shift cap.
		Contained aquatic disposal	Place contaminated sediments in an existing depression, disposal pit, or submerged dike or berm and cap with clean sediment.	PA	
Soil Removal	Mechanical Excavation/Backfill	Backhoe or other earth moving equipment	Remove contaminated soil with excavation equipment and backfill with clean soil.	PA	Effective for removing contaminated soils that may be source of groundwater contamination.
Sediment Removal	Dredging	Mechanical Dredge	Use of a clamshell dredge or conventional earth moving equipment to remove contaminated sediment.	PA	

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Sediment Removal (Continued)	Dredging (Continued)	Hydraulic Dredge	Use centrifugal pumps to remove contaminated sediments in a liquid slurry form.	PA	High water content of dredged material, may require dewatering before treatment.
		Pneumatic Dredge	Use compressed air and/or hydrostatic pressure to remove sediments.	PA	Produces slurries of lower water content than hydraulic dredges.
Groundwater Collection	Extraction	Extraction Wells	Network of wells to extract groundwater in contaminated zone.	PA	Currently in use at site.
		Extraction/Injection Wells	Network of wells for injection of uncontaminated water to increase flow of groundwater to extraction wells or interceptor trenches.	PA	
	Subsurface Drains	Interceptor Trenches	Perforated pipe in trenches backfilled with porous media to intercept and collect contaminated water.	PA	
Sediment Pretreatment	Biological	Nutrient/Microorganism Injection	Inject nutrients or microorganisms into the dredged slurry to enhance biodegradation of organic contaminants	PA	Microorganisms injection has not been demonstrated for large quantities of material.
	Chemical	Chemical Conditioning	Inject chemicals into the dredged slurry to condition sediment for further treatment and/or accelerate settling of suspended solids.	PA	
	Physical	Dewatering	Removal of moisture from dredged sediments by air drying or mechanical processes (e.g., filter presses, centrifuge, gravity thickeners)	PA	

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Sediment Pretreatment (Continued)	Physical (Continued)	Particle Classification	Separates the slurry according to grain size or removes oversize material.	PA	May reduce volume of sediments requiring treatment, because toxic materials preferentially adsorb to fine grained clay and organic matter.
Treatment	Biological	Aerobic Bioreactor	Degradation of organic compounds by aerobic organisms in a fixed or suspended growth bioreactor.	PA	Potentially applicable for remediation of organic compounds. May volatilize contaminants before biodegradation.
		Anaerobic Bioreactor	Degradation of organic compounds by anaerobic organisms in a fixed or suspended-growth bioreactor.	PA	
		Compositing	Biological decomposition of organic contaminants in soil/sediment under controlled conditions, independent of soil medium.	PA	
		Land Treatment	Biological decomposition of organic contaminants by mixing waste into surface soil and using soil managment techniques to optimize degradation.	PA	
	Chemical	Stabilization/Solidification	Immobilize contaminants in a solidified soil/ sediment matrix by adding a solidifying agent.	PA	Limited effectiveness with soils/ sediments contaminated with organics.
		Dehalogenation	Chemical breakdown of halogenated organics into simpler (less toxic) organic compounds by catalysis.	PA	Potentially applicable for treatment of soils/sediments; technology under development for haloaliphatics.

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Treatment (Continued)	Physical	Solvent Extraction	Separation of constituents from a liquid solution by contact with another immiscible liquid in which the constituents are more soluble.	PA	Potentially applicable for treating soils/sediments.
		Adsorption	Adsorption of contaminants in groundwater onto activated carbon or other adsorption media.	PA	Currently in use at site.
		Membrane Separation	Separation of pure water from solution of non-ionic contaminants by passing water through a semipermeable membrane under pressure; or separation of volatile organic compounds from water by applying a vacuum to the water through a dense polymeric membrane which exhibits high permeability for the organic compound but is relatively impermeable to water.	PA	
		Photolytic Oxidation	UV light catalyzes the chemical oxidation of organic contaminants in groundwater by its combined effect upon the organic contaminant and its reaction with hydrogen peroxide.	PA	Potentially applicable for organic compounds.
		Air/Steam Stripping	Transfer of dissolved contaminant from liquid phase into gas (air or steam) phase.	PA	
	Thermal	Incineration	High temperature destruction of organic wastes.	PA	Potentially applicable for contaminated soils/sediments. Not effective for treating aqueous waste - stream.

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Treatment (Continued)	Thermal (Continued)	Low Temperature Thermal Stripping	Transfer contaminants into gas phase by heating contaminated soils/sediment to temperatures less than 1000°F.	PA	Not effective on organics with low vapor pressures (e.g., semivolatiles).
		Pyrolysis	Thermal decomposition of soil/sediment contaminants in the absence of oxygen.	PA	
		Super-Critical Water Oxidation	Oxidation of organics, with air or oxygen, in the presence of a high concentration of water under temperatures and pressures above the critical point of water.	PA	
		Wet Oxidation	Oxidation of wastes by mixing thoroughly with gaseous source of oxygen at temperatures between 150 and 325°C.	PA	
	Off-Site Treatment	POTW	Discharge water to Wyandotte POTW for treatment.	NA	Currently being done with treated water. POTW will not accept untreated groundwater.
		RCRA Facility	Discharge water to licensed RCRA facility for treatment or disposal.	NA	Cost prohibitive for transport of water.
	In-Situ Treatment	In-situ Vitrification	Convert contaminated soils into chemically inert and stable glass and crystalline product by melting soil at high temperatures.	NA	Not applicable for subsurface remediation at operating facilities. Not demonstrated at full scale.
		In-situ Stabilization/Solidification	Stabilize/solidify contaminants in soils by injecting stabilization/solidification agents and water at equally spaced intervals over area of contamination.	NA	Limited effectiveness on organics.

Notes: 1. PA = Potentially Applicable
NA = Not Applicable

TABLE 2 (Continued)
INITIAL SCREENING OF CORRECTIVE MEASURES TECHNOLOGIES
BASF CORPORATION, WYANDOTTE, MICHIGAN

GENERAL CORRECTIVE ACTIONS	CORRECTIVE MEASURES TECHNOLOGY	PROCESS OPTIONS	DESCRIPTION	RATING[1]	SCREENING COMMENTS
Treatment (Continued)	In-Situ Treatment (Continued)	Vapor Extraction	Extract organic vapors from the unsaturated soil zone by inducing a negative pressure (vacuum).	PA	Effective with groundwater extraction which may increase size of unsaturated zone. Not effective in soils of low permeability.
		Bioremediation	Accelerated biodegradation of organics in groundwater by injection of nutrients into aquifer.	PA	Potentially applicable, does not treat inorganics.
		Air Sparging/Bioventing	Removal/bioremediation of volatile organics from groundwater by injecting air under pressure.	PA	
		Dual Phase Extraction	Extract groundwater and organic vapors in soil by application of a high negative pressure (vacuum)	PA	Effective in low permeability soils.
		Metal Enhanced Abiotic Degradation.	Removal of aqueous-phase halogenated organic compounds from groundwater by using a permeable treatment wall containing iron and inert materials.	PA	Emerging technology. Not demonstrated at full scale.
Discharge of Groundwater	Onsite	Outfalls	Discharge of treated water to Detroit River.	PA	Two NPDES permitted outfalls currently discharge to Detroit River.
		Deep Well Injection	Discharge of water to deep well injection system.	PA	
	Off-Site	Publicly Owned Treatment Works (POTW)	Discharge of treated (if necessary) water to Wyandotte POTW.	PA	Currently discharging groundwater to the POTW.
Disposal of Soil/Sediment	On-Site	Lined and capped cell	Dispose of soil/sediment in landfill to be constructed on-site.	PA	
	Off-Site	RCRA facility	Dispose of soil/sediment at off-site RCRA facility.	PA	

Notes: 1. PA = Potentially Applicable
NA = Not Applicable